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TYPESETTING MACHINERY.

With this issue THE ELECTRICAL WORLD changes its method of typesetting from hand to machine composition. THE ELECTRICAL WORLD endeavors to keep in the front rank of progressive journalism, and was one of the first weeklies to adopt machine composition. The typesetting machine was a little crude in those days, however, and the results were not altogether satisfactory, so that for a time the paper had to fall back once more upon hand composition. Recently what is called the linotype, a machine that makes and casts each line of type as it goes along, has reached a degree of perfection sufficient to warrant the publishers in returning to machine composition. By the aid of the linotype THE ELECTRICAL WORLD can not only give subscribers better and quicker service, but each issue of the paper will be printed from absolutely new type. While most of the matter in this number is set by machine, one or two articles are of hand composition. The average reader will probably have difficulty in telling which is which.

CONDUCTIVITY OF CARBON FILAMENTS.

The members of the American Institute of Electrical Engineers were treated to something a little out of the ordinary on Wednesday evening of this week by the presentation of a paper on the "Conductivity of Incandescent Carbon Filaments and of the Space Surrounding Them," by Mr. John W. Howell. It is not inopportune to mention at the present time, inasmuch as blanks have been distributed to the members for the nomination of officers for the coming year, that due care should be taken by all in their selections, with the object of instilling a little more enthusiasm into this rapidly-growing body. Certainly the dearth, with but a few exceptions, of good papers for several months past has not augured well for the prosperity of the Institute, a body now boasting over a thousand in the list of members. The cause for this condition is not to be attributed to too great severity on the part of those discussing the papers presented, as with but few exceptions the discussions have been of a most liberal and instructive nature, and have not, as with several other organizations of a similar kind, had the appearance of attempting to discomfit the author as much as possible. The present standard of the Institute should be maintained by all means, but we believe it is a standard which a large number of the members can easily reach, and it is to be hoped that increased enthusiasm will be evidenced by the presentation of more papers such as that of Mr. Howell on Wednesday evening.

Mr. Howell, in his paper, considered the reversal in the temperature coefficient, first observed by Prof. Anthony, in some forms of carbon filaments, and has demonstrated that such reversal becomes more prominent as the treatment of the filament is increased, the change in resistance being entirely due to the temperature of the filament. This change is apparently brought about by some form of molecular transformation in the layer of carbon which is deposited during the process of treatment. In connection with Mr. Howell's reference to the "Edison Effect," which has been so exhaustively considered by many experimenters, it is worthy of note that the action which takes place between the inner platinum terminals of an incandescent lamp has its direct parallel in the voltaic arc, the positive joint becoming red hot and the negative having soot deposited upon it. This action is in the nature of an electric discharge, and its effects are directly opposite to those which exist due to a similar discharge

between the metal electrodes in air, as has been observed by Mr. Freedman, the negative being the hotter of the two electrodes. Mr. Howell shows that the blue glow in an incandescent lamp is dependent more upon the character of the residual gas than on the degree of exhaustion. He explains also that the reason for lamps burning out at their inner terminals is due to the "Edison Effect," which increases the current in the platinum leading-in wires. This loss of energy, if it could be properly prevented, would lead to a slight increase in the efficiency of lamps.

MYSTICISM.

In an article published elsewhere in this issue, Mr. William Baxter, Jr., refers to a practice which is probably much more common than most of our readers imagine, namely, that of purposely enshrouding everything pertaining to electrical science and its applications in as deep mystery as possible. The electrical profession to the ordinary lay mind is one full of mystery, and those engaged in it, for various reasons, make not the slightest effort to dispel the illusion; they rather encourage it, because it gives them a fancied aspect of wisdom that they might not be able to command were they to pursue a more reasonable course. We know of no reason why reputable electrical engineers should wrap themselves up in a veil of mystery, look solemnly wise and state simple facts in high-sounding terms. People in general know much more about electrical matters than they used to, so that this unprofessional and reprehensible practice cannot be so easily disguised as formerly.

ELECTRIC WAVES.

Those who have kept in touch with the progress made in the study of electric waves were doubtless much interested in the paper read by Prof. Bose last Fall before the Liverpool meeting of the British Association, in which he described a complete apparatus for the study of electric waves. Prof. Bose pointed out that he had succeeded in obtaining a wave length as small as six millimeters, or about one-fortieth of the length which Hertz obtained in his pioneer investigations in this line of research. By means of the apparatus which he devised, Prof. Bose was able to study with electric waves all the phenomena associated with light. According to our London contemporaries, this paper has been supplemented by a lecture at the Royal Institution, in which Prof. Bose showed that any number of crystals, such as beryl, selenite and cryolite, and to some extent tourmaline, are polarizers of electric waves. To these may be added vegetable fibres, such as common jute and even human hair. The fact that ordinary crystals act as polarizers of electric waves indicated to Prof. Bose that their conductivity is different in different directions. Upon investigation he has found that this difference may amount to fourteen times as much in one direction as in another.

In referring to electric waves of short wave lengths, it is interesting to consider the speculations of Prof. Crookes is reported to have indulged in before the Society of Psychical Research. If we may be permitted to judge from the statements of the London correspondent of the New York *Sun*, Prof. Crookes' recent contribution to existing knowledge on waves, both air and ether, has attracted not a little attention in certain quarters. In his lecture Prof. Crookes first considered electric waves of long wave lengths, then passing through vibrations corresponding to the visible spectrum, he reaches that type to which Röntgen rays belong, and finally a period of vibration which he designates as corresponding to "Brain" waves, by means of which one mind, when properly tuned with another, may induce a telephatic chain along which such waves can go straight to their goal without loss of energy due to distance. The period of vibration which these waves must necessarily have is inconceivable. To make the idea at least tangible, however, Prof. Crookes states that if the geometrical progression 1, 2, 4, 8 be continued, electric waves thus far experimented with lie below the thirtieth step, while the region from this step up to the forty-fifth is practically unexplored. Beyond the forty-fifth comes the region of light, while between the fifty-eighth and sixty-first steps Prof. Crookes places Röntgen rays. At the sixty-third step he states that it is not difficult to conceive that rays having this order of vibration pierce the densest media with no diminution of intensity, but pass on without either refraction or reflection with the velocity of light. It is the waves still beyond these that possess properties at present unknown, and which are capable of overcoming all obstructions caused by distance and intervening matter. From a speculative standpoint, these assumptions are most interesting, but it may be asked how one mind is to focus such rays on another, or, going still further, is there sufficient proof that telepathy exists to warrant any such assumptions?

THE TENNESSEE EXPOSITION.

The individuals concerned in the promotion and management of exhibitions usually undertake such enterprises for profit, or gain of some nature. This, however, is not always the influence that impels men to lend their aid to such ventures. National pride, philanthropy and public spirit are frequently controlling factors in large enterprises of this character. The Tennessee Centennial and International Exposition, which will be held in Nashville, Tenn., this year, beginning on May 1, and continuing for six months thereafter, stands unique in the list of expositions, for the reason that it was not conceived and projected on a money-making basis, but was evolved from purely patriotic motives, with no intention of carrying on the enterprise for the purpose of material gain. Exhibitors are not to be charged for space or power, but, of course, provision is made to avoid abuse of these liberal advantages. The projectors of the enterprise are satisfied with what glory may be derived from their efforts, and it should be said to their credit that, judging from the official reports at hand, the exposition will be one in which they may well feel proud. It is planned on a scale that is said to be second only to the World's Fair of 1893, and the buildings, as a rule, judged from an architectural standpoint, are models of classic beauty. There is nothing startling promised in the way of novel features, however, unless the copy of the famous Rialto, that spans the Grand Canal at Venice, be considered as such.

What will chiefly interest electrical people, of course, will be the electrical features of the grounds and buildings and the electrical exhibits. There will be no distinctive electrical building, the exhibits of this nature being presumably included in the machinery and transportation buildings. A separate power house will contain the boilers and engines, and no steam will be admitted into the main buildings where machinery is to be employed. The evident purpose of this is to avoid overheating the atmosphere in these structures. Among the electrical features will be an electrical tower and other attractions of like nature, details of which, however, are not yet available.

This exposition seems to offer an excellent opportunity for those engaged in the electrical industries to do some good missionary work, at least. The South is a rapidly developing section, and electrical manufacturers and dealers, it seems to us, should exert themselves to secure the trade that will sooner or later come from this quarter. There will be no other exposition of this character in the United States during this year, and for this reason alone the opportunity seems to be one worth taking advantage of. It should be stated in this connection that this exposition is held to celebrate the 100th anniversary of the admission of Tennessee into the Union.

Conductivity of Incandescent Carbon Filaments and the Space Surrounding Them.

In a paper presented at the meeting of the American Institute of Electrical Engineers Feb. 17, Mr. John W. Howell discussed the conductivity of incandescent carbon filaments and the space surrounding them, the first part of the paper being based upon one which Prof. Anthony presented before the Institute in 1887, in which he referred to a change from the negative to positive of the temperature coefficient of some carbon filaments which he had observed, which change, however, did not occur in all filaments, and the circumstances under which it occurred he was unable to explain. Mr. Howell stated that a method of coating carbon filaments with metal had been suggested, for which it was claimed that the resistance of the filaments would be much lower at about red heat than it was at higher temperatures. In order to test these assertions, Mr. Howell treated some filaments with this metallic coating, which was applied by heating the filament to high incandescence in the presence of a vapor, which was obtained from a very thick dark-colored liquid, the application being made by the same means as is employed in the ordinary hydro-carbon flashing process. He also treated in an exactly similar manner a number of similar filaments, using ordinary gasoline. To his surprise the gasoline filament showed the same rise in resistance after passing the dull red temperature as was shown by the filaments supposed to have a metal coating. Mr. Howell was then led to investigate the phenomenon. He had previously made resistance curves on a great many Edison lamps which had filaments made without hydro-carbon flashing, and knew that the filaments of all these lamps continued to fall in resistance to the highest temperature which they would stand. The change in the resistance curve was associated with treated filaments. He then made a set of ten lamps with various amounts of treatment, all made from similar base filaments. These lamps had filaments, the resistances of which, when cold, varied from 90 to 10 per cent. of the cold resistances of the original base. Upon plotting the curves of these filaments, he found that the untreated filament fell in resistance as it was made hotter, and that this fall continued to the highest temperature at which he dared to run it. The slightly treated filament fell in resistance more rapidly than the untreated filament at first, and less rapidly as the high temperatures were reached, its curve finally rising above that of the untreated filament. As the amount of treatment increased, the curve fell more and more rapidly at first and less rapidly at the higher temperatures. When the filament treated to 50 per cent. was reached, it was found that it fell rapidly to about 50 per cent. of its cold resistance, and remained practically constant at higher temperatures. The curves of filaments treated less than 50 per cent. all rose after reaching their lowest point, which is reached at about 50 per cent. of their three watts per candle voltage. Such curves may be obtained a good many times from the same filament when there is no permanent change in the filaments which in any way accounts for the rise in resistance. The cold resistance of the filaments after being measured was found to be the same as before any measurements were made. The filaments were then taken from the lamps and put into a baking oven, the temperature of which was raised to about 500 degrees Fahr., and the resistance curves obtained in this way agreed quite well in character with the resistance curves obtained by measuring the volts and amperes of the lamps, so that there is no doubt that the changes in resistance are due to temperature and to nothing else. Mr. Howell then obtained untreated base filaments from as many kinds of amorphous carbon as he could obtain, and plotted their resistance curves. He tried filaments made of bamboo, silk, cotton, cellulose (made by the ordinary squirt process), tamadine and paper. All these base carbons gave the same curve, and all of them continued to fall in resistance as long as he was able to safely increase the temperature. These carbons were quite different in their physical characteristics, the silk filaments being the most porous and having the roughest and best heat radiating surface, while the tamadine filaments were very dense and had a very highly lustrous surface. He is confident that the reverse curve (the curve showing the relation between the resistances in percentages of cold resistance, and voltages and percentages of voltages at 3 watts per candle) is not caused by changes in the character of the surfaces of the carbons due to emissivity, because no corresponding changes in emissivity occur. He found that filaments made of graphite had the same characteristics as the heavily treated filament; it reached its minimum resistance at a dull red heat, and from this point, as the temperature was increased the resistance increased also. The curve, however, reverses much more rapidly and for a much lower percentage of voltage than those previously tested. The resistance of this filament after the measurements had been made was found to be just the same as before they were made. This, Mr. Howell says, indicates quite clearly that calling the treated carbon "graphitic" is correct, and that the change in the resistance curve of treated filaments is due to the graphitic nature of the layer of carbon which is put on during the treating process.

The second part of Mr. Howell's paper relates to the conductivity of the vacuous space surrounding incandescent filaments, and is principally a discussion of the "Edison Effect," which is a name given to the effect produced by those currents, first observed by Mr. Edison, which pass from one leg of an incandescent filament across the vacuous space to the other leg, and which can be observed by connecting a galvanometer between the positive lamp terminal and a wire slid into the bulb and projecting into the vacuous space. Mr. Howell then referred to Prof. Houston's first Institute paper on this subject, and to Mr. Preece's experiments, described before the Royal Society; also to Prof. Fleming's paper, read before the Physical Society of London in March, 1896. Prof. Fleming proved that in well-exhausted lamps the vacuum is not a conductor in the ordinary sense of the word, and that the current which passes through it is charged by negatively charged molecules, which pass constantly from the negative leg of the incandescent filament to the positive leg and to any inserted wire, thus bringing the inserted wire to the same potential as the negative leg. Prof. Fleming also proved that these molecules pass in straight lines and that their passage is completely or almost completely stopped by a glass or mica screen placed between the negative leg and the inserted wire. It has been found that if an alternating current is used to render the filament incandescent, the galvanometer will indicate a current with the connection made to either lamp terminal, because both are equally positive. The current thus produced is a unidirectional one in the galvanometer, and illustrates very well the unilateral conductivity between the incandescent filament and the wire. Mr. Howell stated that he has observed that at a high temperature 0.04 or 0.05 of an ampere more current flowed through a lamp, showing a good blue than though the same lamp at the same voltage when the blue had disappeared. He concluded that this extra current flowed through the vacuous space between the legs of the filament. If a direct current about 20 to 30 per cent. greater than the normal current be passed through a lamp filament when the vacuous space shows a blue glow, the positive joint between the filament and the platinum wire gets red hot, while the negative joint remains cool. He has always considered this as proof that the resistance to the passage of the current through the vacuous space was chiefly at the surface of the positive electrode, as the energy was chiefly developed there. If an alternating current is used both joints get equally hot. If a lamp be burned at normal incandescence with direct current when the vacuous space shows a good deal of this blue, the negative leg of the filament becomes coated with carbon soot. This effect can be obtained in a few minutes if the blue is dense and the filament is run above a normal incandescence. This he has considered to be due to an electrolysis of a hydro-carbon gas in the lamp.

The lamps which show only a slight amount of this blue glow, if burned at normal incandescence, will not show this carbon soot perceptibly, and the blue will entirely disappear if the lamp is burned for a few hours. This blue is caused more by the character of the residual gas than by the degree of exhaustion. Lamps having a residual of bromine vapor do not show it at all, neither do they show any "Edison Effect." Mr. Howell states that he has seen ordinary lamps ready to be sealed off the pumps which showed blue and then no blue, and blue again, at regular intervals of a few seconds. Such lamps show corresponding changes in the "Edison Effect."

If the current be gradually increased in a lamp which shows good blue, the positive joint will get hotter and hotter and finally its platinum wire will fuse. At this stage the resistance to the flow of current across the vacuous space is not great, and if the conditions are such that at this time all the resistance in circuit with the lamp has been cut out, so that the current flowing will be practically determined by the resistance of the lamp and the leads, enough current will flow through the vacuous space to fuse the platinum wires, which are sealed in the glass. This fusion is not due to the same cause as the fusion of the positive joint wire by the vacuum current, because it fuses both positive and negative wires, while the vacuum current fuses only the positive. This fusion of both wires is due to the fact that the low resistance of the vacuous space allows more current to pass than the platinum wire can carry. This is further

demonstrated by the fact that a 10-ampere fuse in the circuit will often blow when this happens.

In order to measure the currents which pass from one leg of the filament to the other across the vacuous space, he measured the current at a given voltage of a number of lamps; first when the lamps showed a good dense blue, before they were well exhausted, and again after the same lamps were well exhausted and showed no blue. Some 55-volt 24-cp lamps showed 0.4 of an ampere more on the first reading than on the second. All of this 0.4 of an ampere must have passed through the vacuous space, for the resistance of the filament remained practically unchanged or became a little lower during the operation.

He also measured the currents which passed across the vacuous space, when these currents were large enough to fuse the joint wire, and also when they were large enough to fuse both platinum leading-in wires. He found that from one to five amperes passed across the vacuous space when the positive joint wire only was fused, and that when both wires leading through the glass was expanded so by the heat of the current that the glass was shattered, the current measured from 10 amperes to more than 25 amperes.

Mr. Howell believes that the heat produced at the positive joints by the "Edison Effect" current is not simply the result of a mechanical bombardment. A lamp was exhausted to show a good blue. The temperature of the filament was raised sufficiently to cause vacuum currents large enough to heat the positive joint red hot. The outer end of the middle wire was then connected to the positive lamp terminal. When this was done the positive joint became cool and the middle wire got red hot. This was repeated several times. The middle wire got hot enough to fuse the end, which was platinum. This indicates that most of the heat is caused by the charged molecules coming in contact with some conductor which will carry away their charge. The current was not measured in this experiment.

He next tried a series of experiments to determine whether the current which passes through the vacuous space when the blue glow is present was the effect of charged molecules moving in straight lines, only, from the negative leg, or whether this current would pass around a screen. These experiments demonstrated that in lamps exhausted so as to show a good blue, the charged molecules have some difficulty in starting their passage from one leg to another around an obstacle, but retain their passage after it has once been established. Also, that their passage around an obstacle is easily established by starting a flow of charged molecules from the negative leg from a small unobstructed part of the vacuous space to an inserted wire, which is connected to the positive terminal, and then breaking the positive terminal connection. He found also that any of the lamps in which the condition of the vacuum is just right, showing the blue glow, will show a current in a galvanometer connected between the wire inserted in the vacuous space and the negative lamp terminal, but in all cases this current is small. One-half milliampere is the largest current he has observed under these conditions. As to the blue glow in the vacuous space, he states that the glow is luminous, and luminosity can only come from matter; consequently, we conclude that the vacuous space, when blue shows, is filled with luminous molecules, and as these molecules are not of themselves luminous, we must seek for the cause of their luminosity. In concluding, Mr. Howell said:

"We have seen that the negatively charged molecules liberate considerable energy on coming in contact with a body that conveys away their charge. We have also seen that when the blue glow is present there is a considerable flow of charged molecules through the vacuous space, and that the naturally rectilineal movements of these molecules are disturbed.

"We also know that molecules are emitted from the positive leg about as plentifully as from the negative leg, although these molecules do not carry a positive charge.

"The conclusion seems to be that the blue glow is a manifestation of the energy developed by the meeting of the charged molecules with other molecules which take away part or all of their charge.

"Well exhausted incandescent lamps which have burned a long time show a black deposit on the inner surface of the bulb. In lamps with thick, stiff, single-loop filaments, in which the two legs lie in the same plane, a light line may be observed in the black deposit, which is caused by the shielding of this line by one leg, from the molecules emitted by the other leg. This line shows with about equal clearness opposite both legs, indicating that carbon molecules are constantly emitted from both legs, equally and in straight lines.

"In lamps which have been imperfectly exhausted, the black deposit sometimes appears in patches, symmetrically placed with reference to the carbon. I regard these figured discolorations as indications of disturbances in the rectilineal paths of the molecules, and of the influence of the magnetic field upon the disturbed molecules.

"The activity of the molecules carrying current across the vacuous space seems to depend more on the temperature of the filament than on the potential difference between the legs, 40-volt lamps showing about as strong effects as 140-volt lamps. The energy they exhibit in one direction seems to be very much greater than we would expect from molecules actuated by a potential difference of only 40 to 50 volts. The action of these molecules in carrying electricity in one direction only, may be an indication of the nature of the action between molecules in solid conductors carrying currents, rather than an illustration of the action of statically charged molecules."

Exhibition in New South Wales.

On June 26 next an exhibition will be opened in the Exhibition Building, Sydney, N. S. W., and will continue during the months of July and August. It is intended to embrace engineering in all its branches, and the exhibits will consist of raw material, manufactured articles, machinery and models (in motion and otherwise), drawings and photographs of all kinds relative to scientific, mechanical and educational works, in classified sections.

There will be no charge for space allotted, but the Executive Committee reserves the right to limit the space of each exhibitor.

The object of the exhibition is solely for the advancement of engineering science and the promotion of a general and practical education therein. It will be non-competitive. The exhibition will be under the patronage of His Excellency the Governor, the Rt. Hon. Viscount Hampden.

Group 4 includes prime movers, comprising steam, gas, electric, hydraulic and hot-air engines, water wheels, turbines, windmills, etc., steam generators, accessories of engines and boilers. Cooking appliances and machine tools are included in Group 5. Group 6 takes in railway, tramway and vehicular appliances, including rails, switches, signalling apparatus, brakes, couplings and also self-propelling vehicles.

Group 9 is one of the most important in the exhibition, and is devoted to electricity. It embraces generators, conductors, testing and measuring apparatus, telegraph and telephone apparatus, electric lighting apparatus, electrometallurgy and electrochemistry, transmission, distribution and utilization of power, lightning conductors, electrothermic apparatus and electro-medical apparatus.

The Executive Committee has appointed Mr. Edward Noyes of Sydney, N. S. W., its representative in Europe and America for the purpose of obtaining exhibits. Intending exhibitors should address all communications to this gentleman, 100 Broadway, New York.

There seems to be an excellent opportunity here for American manufacturers of electrical and engineering apparatus of paving the way for future business in Australia. The exhibition, it is stated, will be largely attended.

Gaining a Week on News.

The Electrical World's Digest of Electro-Technical Literature has become so valuable to readers and the news features of the paper are also so important that the problem has presented itself how it may be arranged that The World shall go to press later in the week, so as to contain later news, and still reach the reader about the time it formerly did. By going to press on Thursday night (instead of Monday night) a whole week's later editions of the various papers can be digested, while news and descriptions of current developments and improvements can be included that otherwise would have to be held over until the following week. The World is endeavoring to make this gain on behalf of its readers. By the use of the linotype machine for setting the type, and a little additional expedition in printing, folding and mailing, it is hoped that much time will be gained, and that as soon as the new system is in smooth working order the paper will reach at least most of its subscribers on the date of publication.

Jungfrau Railway.

From recent published accounts, it appears quite likely that the three-phase system will be used in the bold project, known as the Jungfrau railway, of constructing an electric railway to the top of one of the highest and grandest of the snow-clad Alps. The well-known skill and perseverance of Swiss engineers leaves little doubt that whatever is done will be a success from the engineering standpoint.

The Long Distance Transmission of Power at Hartford.

BY WILLIAM LISPENARD ROBB.

(*Concluded from page 229.*)

THE State Street station supplies the current to the three-wire direct current system, and is operated by the two-phase alternating current, transmitted under 2400 volts pressure from the Pearl Street station.

The change from the two-phase alternating to the three-wire direct-current system is made by means of a rotary transformer (Fig. 14) and two step-down static transformers. The rotary with its accompanying transformers receives the alternating two-phase current at about 2400 volts pressure and delivers direct current to the three-wire system. The capacity of the rotary rating is 250-kw and its normal rating is 833 amperes at 300 volts. It has been underrated. In general the machine is similar to ordinary direct current generators. There is a substantial field casting, with 14 radial poles which are of laminated iron cast into the yoke. The field coils are connected in series and are supplied with current taken from the bus-bars. The armature (Fig. 11) is of the slotted type, the windings consisting of copper bars bent into the form of coils, thoroughly insulated and then readily placed upon the armature. Connections are made to the commutator in the usual way. At the end opposite to the commutator are four collector rings which are connected at the proper points in the winding to deliver two-phase currents if the machine were run as a generator or to receive two-phase currents when operated as a rotary transformer.

The machine is started by a small induction motor mounted on the end of the shaft. In this motor the secondary, which is pressed on the end of the shaft, has a winding consisting of copper bars placed in slots of the iron. The ends of the bars are connected to heavy rings. The primary surrounds the secondary and is wound for 200 volts. When the starting motor is connected to the circuit the machine is quickly brought up to normal speed and the main armature is then connected to the circuit.

It is customary on a three-wire system to use two machines, each for half the voltage. This requires two small machines instead of one large one as well as a correspondingly increased number of commutators and brushes. With this machine, however, the middle wire of the system is derived in a simple and novel manner which was worked out by Mr. B. G. Lamme, of the Westinghouse Electric & Manufacturing Company. A connection (Fig. 16) is made with the middle points of the secondary coils of the step-down transformers by which the rotary is supplied with current. The potential of this point is midway between that of the two direct current brushes of the rotary. The E. M. F. between the middle wire and the two outside wires is practically equal and independent of the difference in load on the two sides. In fact, there may be no load on one side of the system and one set of direct-current brushes may be removed and the system will still receive its normal current from the middle point of the transformers and the remaining set of direct-current brushes.

The voltage at which the direct-current is delivered can be raised at will from 230 volts, which is that required at times when the rotary supplies the distributing circuits, up to 360 volts which may be required when the battery is to be charged at a rapid rate. This adjustment of the voltage is made by changing the ratio of the step-down transformers by varying the number of turns of the primary. This change is made by a regulator (Fig. 13) with a large number of contacts connected to the proper points in the primary winding and arranged so that the voltage is raised from the minimum to the maximum by thirty-six steps. The line connections may be successively made to these different points by moving the handle of the regulator. The contacts are in duplicate on the two faces of the regulator, one set for each phase of the circuit. The regulator is so designed that by the forward movement of the lever the voltage of one phase is raised and by the backward movement that of the other, thus obviating the throwing off of the entire power during the instant the circuit is broken, while cutting in or out turns of the transformer. The voltage is lowered in a similar manner, the lever being arranged so that by a partial revolution about its vertical axis, the movement of the contact piece is reversed. The regulator is placed in the primary circuit as the current is small and the large contacts and connecting cables which would be required on the low tension side are avoided. The great range of voltage through which the rotary may be operated does away with the boosters usually necessary in charging storage batteries.

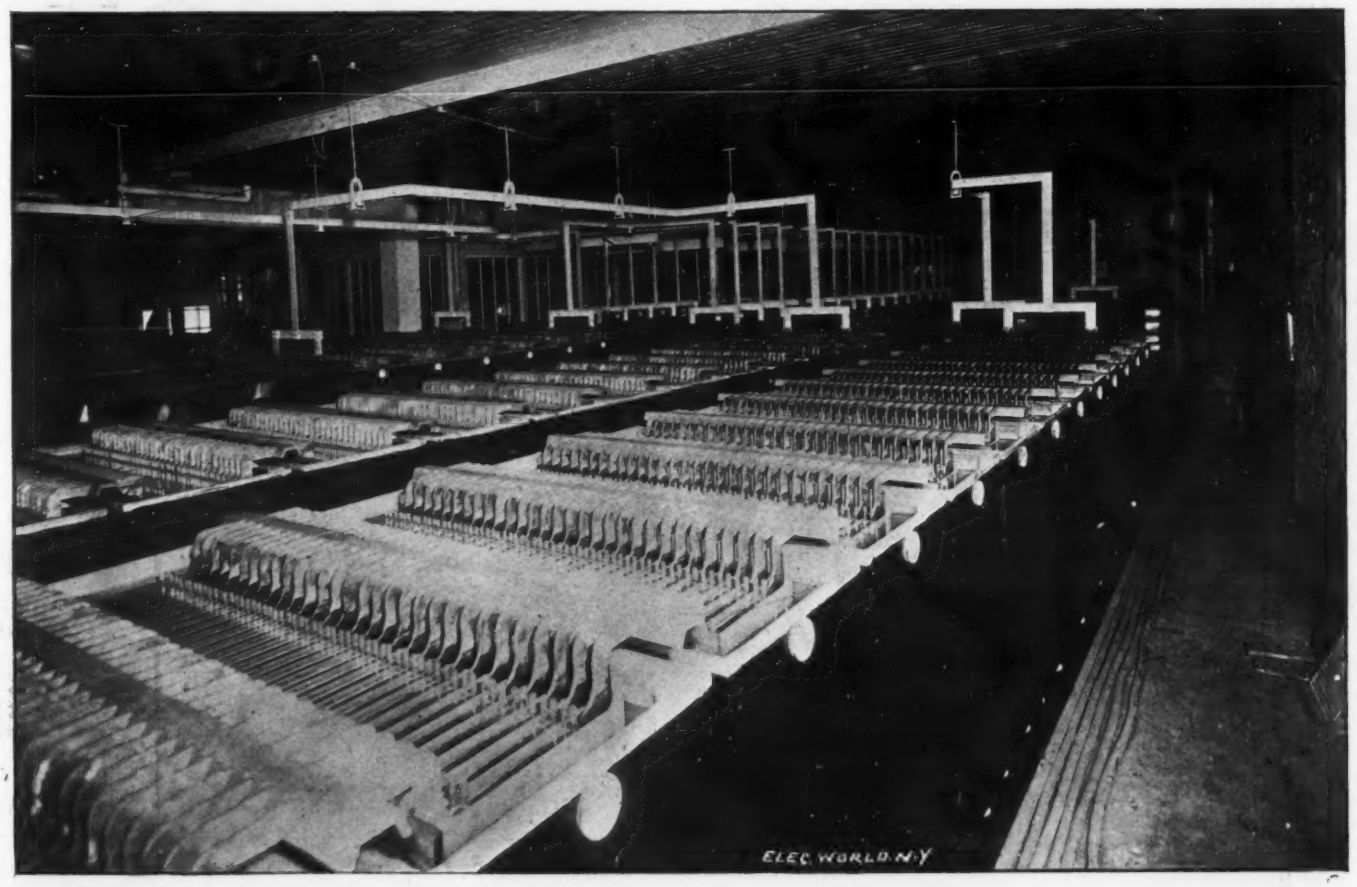


FIG. 10.—STORAGE BATTERY.

The rotary has been in continuous operation for the past three months at an average output of nearly full load for 18 hours a day. The direct-current commutator is practically free from sparking, sparking as little as any direct current commutator of the same capacity with which the writer has had any experience. As an illustration of the character of the machine, it might be mentioned that during the first charging of the battery circumstances necessitated one side of the battery being charged before the other, consequently the rotary was run continuously for 24 hours with a load of about 950 amperes on one side and no load on the other.

The simplicity, the range and flexibility of this rotary transformer are marked features of the Hartford plant and nowhere else can be found the means of transforming from a high-tension multi-phase alternating to a low-tension, three-wire, direct-current system of variable voltage by means of one regulator, two step-

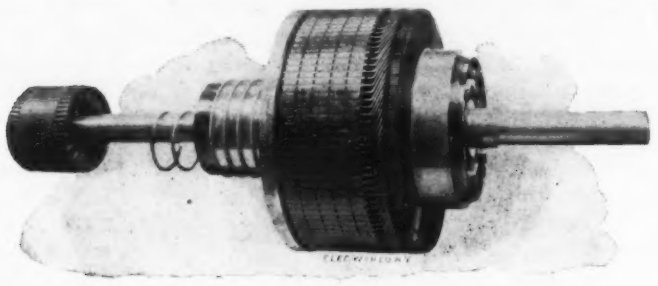


Fig. 11.—Armature of Rotary Transformer.

down transformers, and a single machine with but two sets of brushes upon the commutator. The development of this type of rotary transformer certainly reflects great credit on the engineering staff of the Westinghouse Electric & Manufacturing Company.

The State Street station is also equipped with a storage battery, (Fig. 10), of a type manufactured by the Electric Storage Battery Company of Philadelphia. It consists of 130 cells, 65 on each side. Each cell, made of oak and lined with lead, contains 31 negative and 30 positive plates. The plates are made in two parts, each being 15.5 by 15.5 inches. The negative plates are of the Chloride type but the positive are the Manchester type of Planté plate. The

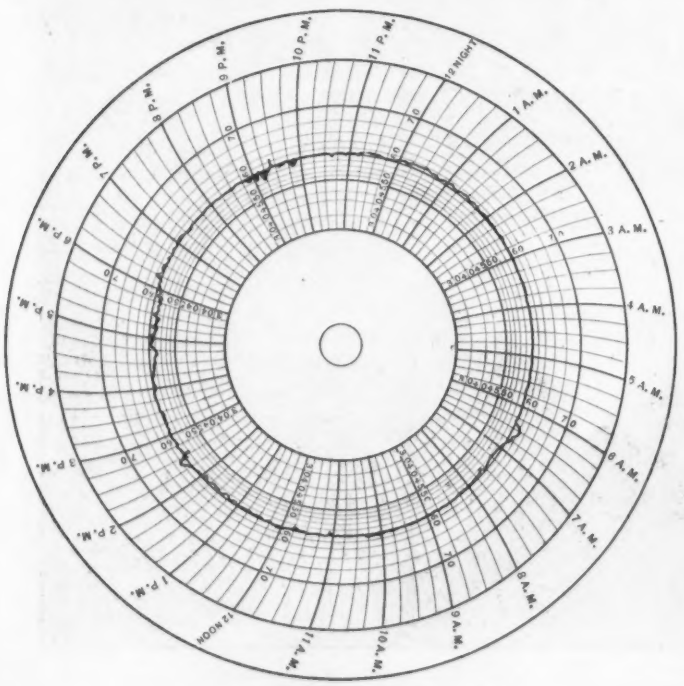


Fig. 12.—Regulation Curve.

battery is capable of discharging at the rate of 1700 amperes on each side for five hours, and by the terms of the guarantee the battery may be discharged at a one and a quarter hour rate if it is so desired. Twenty cells on each side of the battery are connected with end-cell charge and discharge switches similar to those installed on all recent central station batteries. These switches are mounted vertically as shown in Fig. 15.

The switchboard connections are so arranged that the battery is at all times connected with the distributing bus-bars, whether charging or discharging, or when the battery and rotary in multiple supply current to the lines. Consequently the battery at all times is ready to supply the current called for by any sudden increase in the load. Owing to the connection of the alternating to the direct-current system through the rotary, the battery takes care of sudden fluctuations in either system equally well. As an illustration of this it may be mentioned that in one case the battery was allowed to supply current through the rotary to the alternating system for some fifteen minutes. This, of course, could be done only with excessive loss of energy and would not be done except in case of great emergency when continuous service was of more importance than cost.

As will be seen from Figs. 15 and 16 the direct-current circuits are protected from overloads by automatic magnetic circuit-breakers placed in the positive and negative legs of the circuits and are controlled by knife switches in the positive and neutral.

A second rotary transformer is about to be installed and the

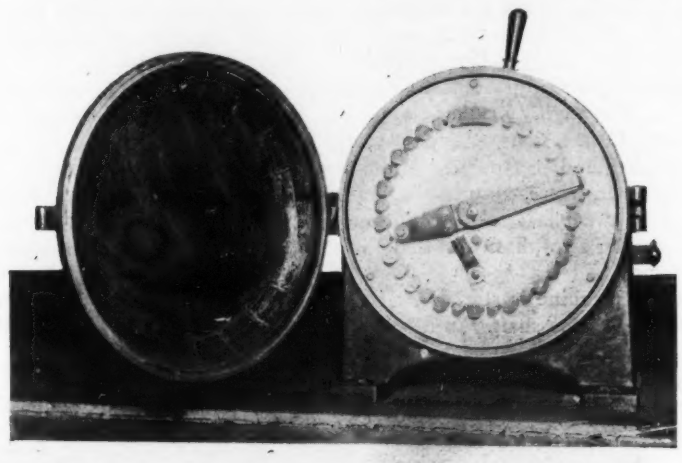


Fig. 13.—Regulator for Rotary Transformer.

switchboard is so designed that both rotaries can be used in multiple for charging the battery or for supplying current directly to the distributing bus-bars with or without the battery, or one rotary can be used to furnish current directly to the three-wire system and the other used independently to charge the battery.

Ammeters are placed on the switchboard to give the load on each rotary and on each of the feeders. Differential ammeters give

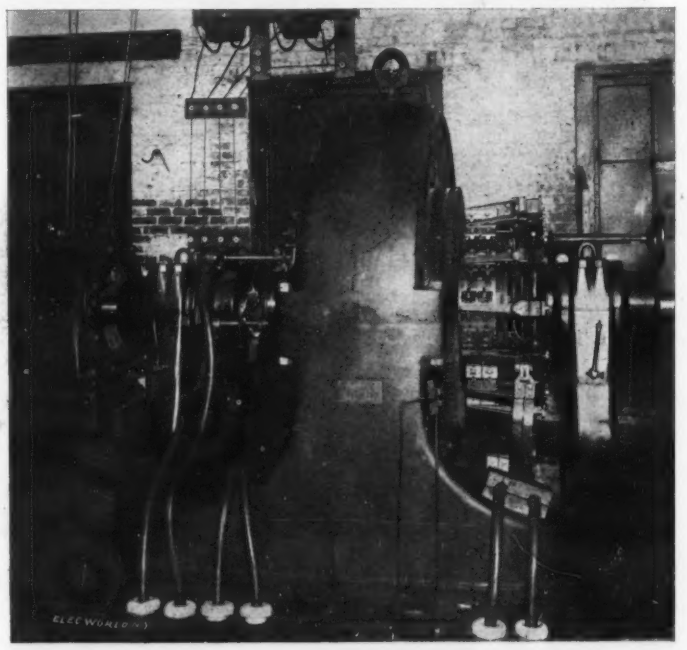


Fig. 14.—Rotary Transformer.

the charging or discharging current of the battery and the total output of the station is given by ammeters on the load panel while a voltmeter on the same panel can be connected by a sliding-contact switch with pressure wires leading to the different junction boxes of the underground system.

The system of underground distribution is the well-known Edison

3-wire direct-current system modified to the extent that cables drawn in ducts are used as feeders instead of the more common Edison tubes. The feeder cables are paper insulated and lead covered, and were manufactured by the General Electric Company. The pressure wires are in the same covering with the cable. Paper insulated lead-covered cables of the same make are also used for transmitting the high tension alternating current underground from Pearl Street to the rotary. Several one hundred light series arc circuits on the overhead system are fed through underground cables crossing the underground district. For this work rubber insulated lead covered cables manufactured by the New York Safety Insulated Wire & Cable Company are used. Rubber insulated cable of the same make but with heavier insulation is also used on the underground portion of the 10,000-volt long distance transmission.

The benefits obtained from the changes described in this article may be summarized as follows: The amount of water power available has been greatly increased by raising the dam at the Farmington River. Although the amount of power transmitted to Hartford has been increased and no addition made to the amount of copper in the line, the percentage lost in transmission has been materially diminished as the current is now transmitted at 10,000 volts pressure instead of at an average of less than 6,000 as formerly. All the copper on the transmission line is now continuously in use owing to the fact that the alternators are run in parallel. The advantages of the three-phase system in transmission and the two-phase in distribution are both obtained through the Scott method of transformation. The use of induction motors and of rotary transformers has been made possible by reducing the frequency from 133 to 60 cycles per second. It has been possible to continue the use of the old single-phase 1200-volt alternating circuits without any change by making the proper connections with the transformers stepping down to 2400 volts. The continued use of the old transformers on the single-phase circuits was also made possible by limiting the reduction in frequency to about 60 cycles. The rotary transformer makes it possible to take advantage of the economies of the alternating system in the transmission of the power to a sub-

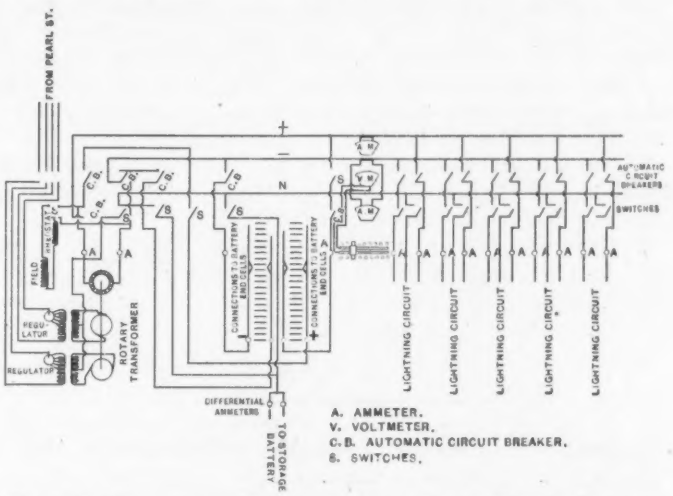


FIG. 16.—DIAGRAM OF CONNECTIONS AT STATE STREET STATION.

station and its conversion there to the three-wire direct-current gives all the advantages of that system in distribution. It is now necessary to operate but one steam plant and to operate that only under a load sufficient to reduce the cost of production of electricity by steam to a minimum. The introduction of the storage battery has greatly increased the average load on the water power and diminished the use of steam at the peak of the load. With a possibility of delivering at Hartford a maximum of 1200 horse-power the amount received from the Farmington River has averaged as high as 980 horse-power for the entire 24 hours. As the direct current system is connected with the alternating through the rotary transformer the storage battery acts as a regulator for both systems and

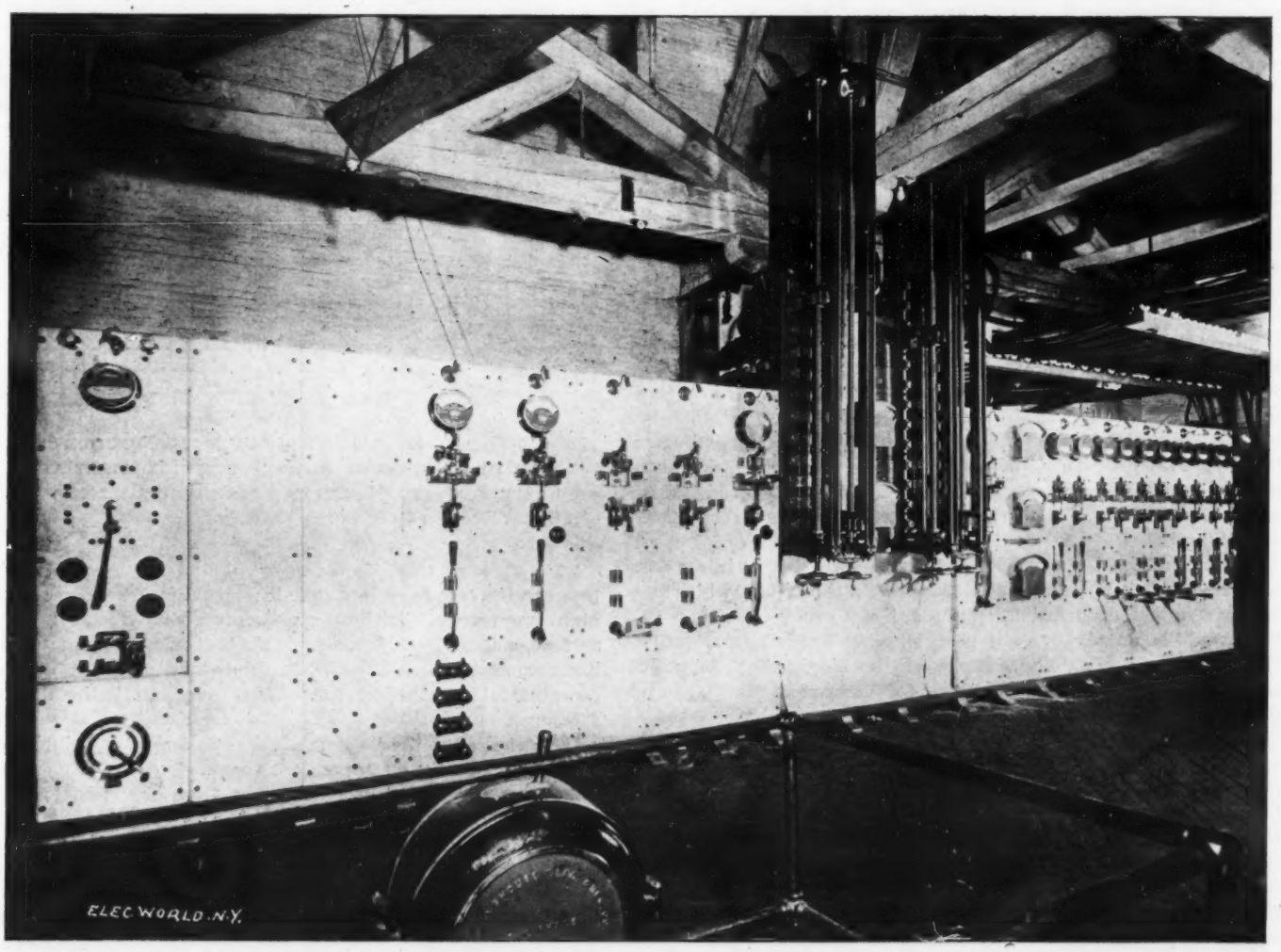


FIG. 15.—SWITCHBOARD AT STATE STREET STATION.

the percentage change produced by any fluctuation in the load on any part of the entire system is reduced to a minimum.

The accompanying record Fig. 12, of the voltage on the alternating system for the twenty-four hours ending at noon, Feb. 4, 1897, shows the regulation that can be maintained on an alternating system working under the Hartford conditions. The record was taken at a point about half a mile from the central station and on one of the most heavily loaded lines in the city.

The alterations made during the past year have materially reduced the cost of operating and greatly improved the reliability and quality of the electric light service.

[I note a misstatement in the article in THE ELECTRICAL WORLD Feb. 13. The last paragraph on page 229 states that the armature of the 600-kw motor is wound with wire. The armature is, in fact, wound with copper bars, there being several in each slot, instead of but one, as is the case in the winding of the 600-kw generator.—W. L. R.]

Luminous Efficiency of the Alternating-Current Arc.

BY A. E. BLONDEL, ASSISTED BY E. JIGOUZO.

(*Concluded from page 233.*)

Influence of Current Density.—This is shown in the curves of Fig. 5, which were constructed with the same carbons, the current intensity varying slowly from 0 to 25 amperes, by varying the voltage, and also by the curves in Fig. 5 obtained in maintaining the voltage constant at 41 volts. It is to be remarked that at about 20 amperes the curves in this figure are inflected, showing an excessive combustion of the points of the carbons. Below this value, which is, moreover, absolutely out of the question for carbons of 10 mm in practice, the curve is sensibly parabolic, which proves that the efficiency augments with the intensity of the current, which is by no means astonishing.[8]

Influence of the Form of the Current Wave.—The influence of the form of the wave of current upon the efficiency of the alternating current arc is only a special case of a general law enounced some years ago by the author. It is known that the mean temperature of the carbon points diminishes when the durations of the extinctions of the arc increase. Then, as has been shown in another place, the arc extinguishes and relights, according as the difference of potential between its terminals is less or greater than a certain limit, *A B*, Fig. 8, which depends upon the separation of the joints and the nature of the carbons. The extinction of the arc is then the more prolonged, when the current intensity varies more slowly in the neighborhood of zero values. It will be very long for a curve of the form *A*, and will attain, on the contrary, a minimum for a curve having a rectangular form, *B*.

This effect has been verified experimentally by an interesting research of Herrn Wedding and Roessler,[9] but the form in which they have given their conclusions is not entirely exact, since they say there would be an advantage in using alternators giving a rectangular E. M. F. Such an alternator when working on an inductive circuit would give a very rounded wave of current, as shown in Fig. 10.

In reality, what should be considered as theoretically desirable for an arc is a rectangular current, which unfortunately cannot be realized in practice. The best proof that it will not suffice to consider the form of the E. M. F. is that in connecting to a system of which the alternators have an E. M. F. analogous to that of Fig. 8, but in which there is considerable self-induction we have found the efficiency sensibly equal to that given by an alternator having a sinusoidal E. M. F., Fig. 9. This shows very plainly that under full load the distributed current takes a form analogous to the sinusoidal.

For the same reason, the fact that certain carbons tend to deform the wave of potential difference at their termini, and also to render it rectangular, which I remarked in 1893 and which M. Frith has since recognized, cannot at all permit the conclusion that the efficiency of the arc will be bettered, since the current-wave is not found to be sensibly modified in form.

On the contrary, we have put in evidence the influence of the current form in comparing the arcs obtained from an alternator of the Lapour type (curves of Fig. 1) having a sinusoidal E. M. F. producing a current equally sinusoidal, and the arcs obtained with a direct-current, continually reversed periodically at very short intervals. This current was obtained by means of a commutator turning with a velocity which could be varied at pleasure, permitting from 25 to 200 reversals per second of the current from a battery of accumulators. A veritable alternating-current, comparable to ordinary alternating-currents, was thus obtained, but presenting a law of rectangular variation. The results with this current are given by the curves of Fig. 3 and Fig. 1. It is seen that with the effective intensity equal at 10 amperes, the voltage the same (40 volts) and equal frequency (50 periods), the rectangular current-wave gave 7900 lumens instead of 5900—an increase of one third in the luminous efficiency. This shows that the duration of extinction of the arc is reduced to zero, whereas it easily attains one quarter of an alternation in the case of the sinusoidal current.

Influence of Frequency.—By turning the commutator, which has just been mentioned, at different speeds, we have been able to obtain various frequencies, extending from 25 periods per second, the limit at which the flickering of the arc became sensible, to nearly 200 periods, a limit imposed upon the apparatus by centrifugal force.

We had expected to find an increase of the efficiency with the frequency, but there was none. On the contrary, Figs. 3 and 7 show that the flux diminshes notably when the frequency passes from 27 to 119 periods, other things being equal. Fig. 4 indicates in a most complete manner the effect of this variation for Helios carbons. The apparent conditions being constant (10 amperes, 33 volts) the total flux varied from 5400 to 4210 lumens, about 20 per cent., while the frequency went from 25 to 200.

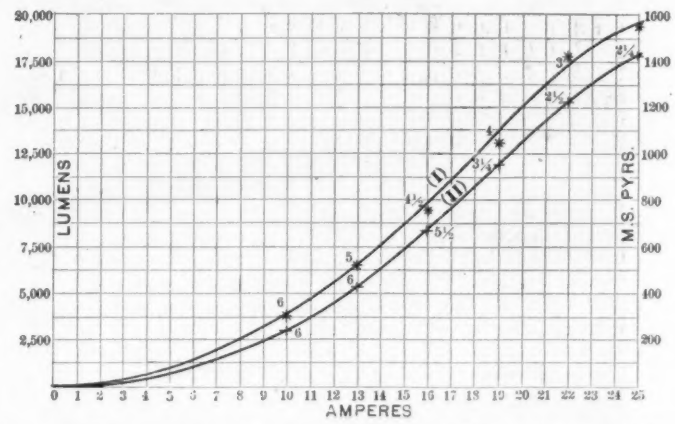


FIG. 6.—VARIATIONS OF LUMINOUS FLUX AS A FUNCTION OF THE CURRENT FOR CARBONS OF 10 MM; PRESSURE CONSTANT AT 41 VOLTS. CURVE I, CORED NANTERRE LIGHTHOUSE CARBONS; CURVE II, CORED HELIOS CARBONS.

This effect we think should be attributed to the greater distance between the carbon points that is realized for the same voltage at high frequencies. In the experiments above it was 1 mm at 25 periods, 2 at 100, and 3¼ at 200. As the efficiency diminishes with the distance between the carbon points beyond a certain limit it is conceivable that the increase of frequency can indirectly produce this result.

We were led to the same conclusions in employing sinusoidal currents (of which the curves are not given).

Conclusion.—Notwithstanding that these experiments are not as yet entirely complete, they are sufficiently advanced to permit several interesting practical conclusions to be drawn.

1. The efficiency of the alternating current arc depends in a large measure upon the nature and diameter of the carbons, the density of the current and the distance between the carbon points. It is then absolutely necessary, when it is desired to compare different arcs, to take account of this fact.

In particular, when it is wished to compare it with the continuous current arc, there should be adopted for both the same density of current in the carbons and the same energy, and care should be taken to put each in the condition of maximum efficiency corresponding to that density of current, in such a way that the comparison shall be equitable. The elements of this comparison, to which we shall return in a forthcoming article, are furnished by the results of our preceding memoir and the present work. It will be found that they make evident the superiority of the continuous current arc, without making it so great, however, as has been sometimes claimed.

2. The efficiencies vary according to the make of the carbons and the conditions of their employment, in such proportions that it does

[8] Afterwards the experiments were continued with Siemens' carbons, but they will not be complete until later.

[9] *Electrotechnisches Zeitschrift*, Aug. 22, 1895.

not appear to be possible to indicate them *a priori* in a reliable manner. The best plan is to submit each lamp of a new maker with whom it is wished to deal to a test with the lumen-meter, which makes known the total light with the greatest facility.

3. There is no reason to seek to augment the frequency of alternators; the carbons suitable for each frequency should, however, be employed to obtain the best effects possible from two frequencies as different as are the extreme limits of 40 and 125 actually employed. With the same carbons the efficiency decreases when the number of periods is increased.

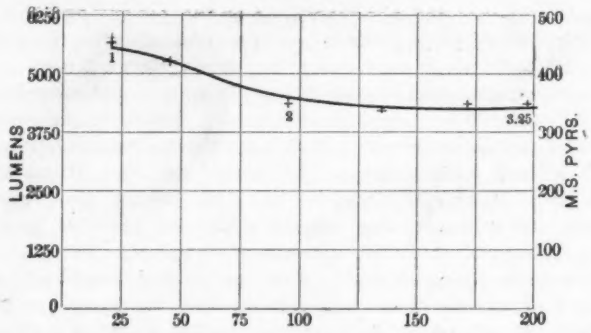
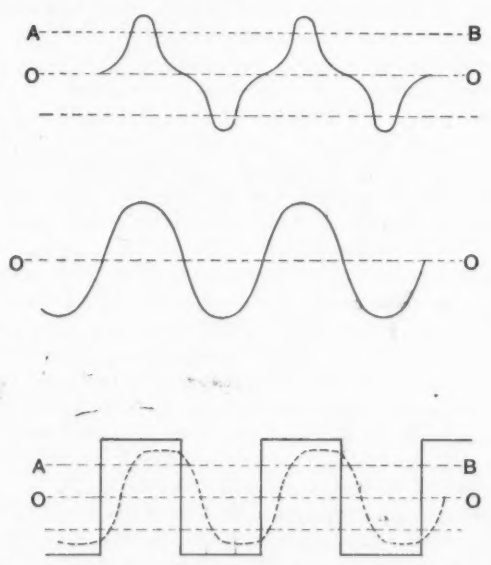


FIG. 7.—INFLUENCE OF FREQUENCY UPON THE EFFICIENCY OF THE ARC UNDER CONSTANT CONDITIONS OF 10 AMPERES 33 VOLTS; 10 MM CORED-CARBONS. (HELIOS).

4. The inferiority in efficiency of small arcs as compared with large ones, indicates that the latter should always be used when possible. It should be endeavored equally to reduce the diameter of the carbons as far as considerations of consumption permit, and to this end it should be sought to lengthen the feed of the lamps as much as possible.

Beyond a short length of arc the luminous flux diminishes very quickly, more so than for continuous current. Long arcs should be carefully avoided in employing alternating currents, at least with the carbons used in Europe.



FIGS. 8, 9 AND 10.—VARIOUS FORMS OF E. M. F. CURVES.

The form of the curve of E. M. F. plays a scarcely noticeable part in the limits in which it varies among ordinarily well-constructed alternators. It is the form of the *current* wave that must be considered, and not that of the potential difference at the points, which is commonly regarded. Making it *rectangular* enormously increases its utility, but as the practical means for providing such currents industrially cannot be had, the fact has only a theoretical interest.

Practical formulas for the evaluation of luminous power will be given in another article.

Poles in Germany.

There are about three or four million poles for overhead electric lines in Germany, and their average life is from 12 to 15 years.

Dissimilar Action of Similar Machines.

BY WM. BAXTER, JR.

There are many men whose mental tendencies are such that they derive an enormous amount of pleasure from the contemplation of any scientific subject in the light of an inexplicable mystery. Such men are not confined to those who have derived their knowledge from practical experience exclusively, but include many who are thoroughly familiar with the highest grade of technical literature, with all the fundamental laws of nature and with all the theories, accepted or unaccepted, in relation thereto. Many of these men know that the position they take in endeavoring to shroud in mystery any particular action that is not at all obscure is not tenable, and they will not pretend to assert that it is, but for all that an unconquerable desire compels them to say that it can only be regarded as one of those things that cannot be accounted for.

All this marveling over these assumed incomprehensible caprices of nature, is brought about by an overwillingness to accept as real conditions that have no actual existence. Our present knowledge of the laws of nature is sufficient to enable us to say without qualification that if two machines are identical in every respect, their action will be the same in every respect when under similar conditions; and the fact that the operation of the two is not the same is a positive proof that there is a lack of similarity in their construction. In addition to this it is not difficult to show that to make two machines exact duplicates of each other is a practical impossibility, and therefore dissimilarity of action is not an inexplicable mystery, but on the contrary the unavoidable result of the conditions that actually prevail. The magnitude of the difference in the action of two machines really serves as an index by which to gauge the accuracy of their construction, and the difference can never become zero unless perfection is attained.

If we consider the causes which interfere with obtaining uniformity of action, we will find that they are very numerous and that some are practically beyond the control of the manufacturer. As an illustration, consider the case of two railway motors; it will be found that there can be electrical, magnetic and mechanical differences. The electrical differences cannot have any great effect upon the operation, in fact, not great enough under ordinary conditions to cause a difference sufficient to be detected by the ordinary methods of testing. The magnetic differences, however, can be formidable and so can the mechanical, and what is more they will be such unless the greatest care is exercised in the process of manufacture.

In separating the causes of difference in action according to the foregoing classification, an arbitrary method must necessarily be followed, and the determination of the heading under which to place any particular cause, will depend wholly upon the point of view from which the classification is made; this point of view in the present case is taken with reference to the constructive features.

Under the electrical heading we can place the difference in the resistance of the wire, which may be due to inequality in length, or in diameter, and also to a difference in conductivity. The length of wire in the two armatures will be practically the same, although not actually so, but in the field coils there is more room for discrepancy. In the diameter the variation as demonstrated by practice is very slight, and seldom enough to be noticeable. The difference in conductity may be as much as 6 or 7 per cent., but ordinarily is not over 1 or 2 per cent. There is another way in which the electrical similarity may be destroyed, and that is in the number of turns of wire; these will be the same in the two armatures, but in the field coils may differ as much as 1 or 2 per cent., hence on this account the magnetic flux may be affected. The total difference in the electrical resistance of the motors may, in extreme cases, be as much as 6 or 7 per cent., but in 90 cases out of 100 it will not be over 2 or 3, and as this is at the most only 8 or 10 per cent. of the total resistance opposed to the E. M. F. of the operating current, the effect upon the action of the motors cannot be over two thirds of 1 per cent., and in the great majority of cases, not over one quarter of 1 per cent. The difference in the number of turns on the fields cannot affect the flux by more than a fraction of 1 per cent., therefore the total inequality due to the electrical differences cannot be so great as to be measured with certainty by the instruments generally used for testing motors of that size.

Under the magnetic heading will be considered only the magnetic properties of the metal constituting the magnetic circuit. It is generally supposed that if the permeability is not very high the results

will be very poor, and writers upon the subject of electrical machinery design invariably state that only the very finest grade of charcoal iron should be used. This would be very good advice if it could only be followed, but those who have had experience in the manufacturing line know that 99 per cent. of all the charcoal iron in the market at the present time is steel. Sheet iron is practically a thing of the past, and although a small amount of it is made and may find its way into the armatures of motors and generators, by far the greatest number of these are made of steel, which may possibly possess the property of giving better results when known by another name.

The difference in the results obtained by using different qualities of the same metal, in apparatus having a closed ferro magnetic circuit, is very decided, but it is not necessarily so with motors and generators; the use of a different metal will, however, greatly affect the output of the latter machines. If the field in one case is made of cast iron, and in the other of steel, the capacities will be in the ratio of about two to one. There are many men who believe that the only difference between cast iron and steel or wrought iron, is that the latter requires less magnetizing force to develop a given flux, and therefore, that the former can be made to do just as much by simply placing more wire upon the field. This is an erroneous notion that has led many into serious mistakes. A density of, say, 14,000 lines per square centimetre can be obtained in steel or iron with about 20 to 25 ampere-turns to the centimetre of length, but the same density in cast iron is almost beyond practical limits.

The difference between wrought iron and steel of different grades is principally that they require more or less magnetizing force to develop a given flux, but the highest practically attainable density is very nearly the same, whether the quality is good or bad.

The armature is the part that suffers the most by the use of an inferior grade of metal, and this is due to the fact that the hysteresis loss is materially increased. This raises the temperature and as a result reduces the current-carrying capacity of the wire, and therefore the output. Making the field of low grade iron or steel will tend to reduce the flux density, but unless the air gap is very short, and the magnetic circuit very long it will not have a very noticeable effect upon the actual strength of the field, as will be shown in the consideration of the mechanical causes of difference.

Some years ago the writer experimented with different grades of armature iron, as it is called, or more properly sheet steel, to determine what relation the results obtained with the various grades bore to the difference in price. The test was made by constructing two armatures, one of the highest grade of metal, and the other of the cheapest stove pipe iron obtainable. The armatures were placed in fields as nearly alike as possible, and after the first results were noted, were exchanged, so as to get the behavior of both in each field. The results were such as to show that there was a difference in the operation of the two armatures, but it was not enough to be measured with certainty. The difference in the temperature, however, was so great as to materially reduce the amount of current that could be carried without danger of overheating, thus reducing the maximum capacity of the motor.

Steel is almost universally used at the present time for the fields. It is of remarkable uniformity, if always obtained from the same foundry, so much so that the output of the machine cannot be greatly affected by the slight variations in its qualities, although sometimes there is a sufficient lack of uniformity in the density to cause a decided increase in sparking. This will be the case when hard spots upon the pole-pieces interfere with the normal distribution of the flux over the surface. If it were as difficult to obtain a fair degree of uniformity in the magnetic qualities of iron or steel as is often supposed to be the case, it would be practically impossible to predict the result obtainable with any machine, but fortunately the difference between high and low grades of iron and steel is not so great as to interfere seriously with the results.

In the majority of machines there is perhaps no one cause that will affect the capacity more than a difference in the width of the air gap, but this difference is more under the control of the manufacturer than any of those already considered, as it is dependent wholly upon accurate workmanship. As is evident, it is a mechanical difference, which can be reduced to a minimum, if a proper effort is made, but as it can have a greater effect upon the capacity of the machine than anything else, we are justified in assuming that difference in capacity is generally an index of the quality of workmanship. Lack of accuracy in this direction will produce more serious differences than electrical or magnetic inequalities, not only because the defect can be greater but also because the inequalities of an electrical and magnetic character can neutralize each other to a considerable extent.

To show what a difference in the length of the air-gap may amount to it is only necessary to call attention to the fact that at the ordinary degree of density used in well-designed machines the permeability of the iron part of the circuit is from 500 to 1000 times that of air, and as the total length of the circuit is anywhere from 50 to 200 or 300 times the length of the gap, it follows that the latter constitutes the principal part of the resistance. It is also on this account that differences in permeability do not produce any noticeable changes in the total flux. As an illustration, suppose that the flux density is such that the permeabilities of the air-gap and the balance of the circuit are in the relation of 1 to 600 and that the air-gap is half an inch in length, while the length of the circuit is 50 inches, then of the total magnetizing force the gap would require six sevenths. From this it will be seen that a defect in the iron will only effect one seventh of the resistance in the circuit, but in the air-gap it will affect nearly the entire circuit. This also explains why an inferior grade of iron in the armature has but little effect upon the output, while it greatly increases the temperature. It is sometimes supposed that if the armature heats up considerably the capacity and the efficiency will be greatly reduced. This, however is only true with respect to the latter. It can easily be seen that as the loss in the armature under ordinary conditions is only 4 or 5 per cent. all told, an increase of 1 per cent. will be noticeable, and 2 per cent. decidedly so, but as it will increase the amount of heat generated by 20 to 40 per cent., it would only affect the output of the machine by an amount too small to be detected, and if the wire were of sufficient size to carry the maximum current in addition to the increased amount of heat generated by the inferior grade of iron, the effect upon the output would not be noticed unless the machine were run considerably overloaded. A change in the air gap introduces a disturbance that affects nearly the whole circuit, and the result is that the flux is increased or decreased, almost in direct proportion with the variation in the length of the gap, and therefore the operation of the machine is affected in a similar ratio.

From the foregoing it will be seen that a difference in the conductivity of the wire, or its diameter or length or a difference in the permeability of the iron in the magnetic circuit, will affect the efficiency to a noticeable extent, but will not produce any material change in the capacity. A difference in the length of the air gap, however, will affect the capacity as well as the efficiency. In the case of a motor, an increase in the length of the air gap will cause a decrease in the counter E. M. F. and therefore an increase in speed. The inequality of two motors is more noticeable when they are connected in parallel than when running singly, owing to the fact that one acts against the other, and thus the defect is magnified. This is particularly the case if all the terminals of fields and armatures are connected in parallel, for then while the current will divide between the fields in proportion to their respective resistances, it will divide between the armatures in proportion to their counter E. M. Fs. When each motor is in a separate circuit from end to end if the current through the armature tends to increase by reason of the lower counter E. M. F , the same increase is experienced in the field and as a result the latter is strengthened and the induction raised, thus checking the further increase in current.

The conditions considered up to this point will affect the efficiency, the capacity and the temperature of the machines, but it very often happens that the difference in these directions is not noticeable, and the only inequality in a practical sense is the behavior at the brushes. Differences in this direction may be due to actual inequalities in construction, or to differences in the permeability of the metal in the pole-pieces, but the latter is very seldom the cause When a machine is in motion the density of the magnetic flux increases from the back to the forward edge of the pole-pieces, and the machine being designed with due consideration to this fact, the brushes will not spark, but if through an unequal permeability of the metal in spots the uniformity of this increase is destroyed sparking will be the result. As a rule, however, the excessive sparking in one machine is due to differences in the construction of the commutator. If the copper of which the segments are made is of such hardness and texture that it will wear away at the same rate as the mica insulation, the surface of the commutator will preserve a true cylindrical shape, but if the metal is harder or softer than this the cylindrical shape will be destroyed. If the segments are harder they will wear with a hump in the middle, and a depression will be formed over the insulation. The brush will, under such conditions,

chatter over the surface and will, as it rides onto one hump, break contact with the preceding segment too soon, and thus cause a spark that will increase the difficulty by burning away the metal at the edges, and thus increase the irregularity. If the metal is too soft the segment will be hollowed out, and as the brush rides up on an insulation it will break contact with the segment and cause sparks to pass between it and points on the surface of the segment some distance from the edge, and thus lower the surface still more. Whether the sparking is due to imperfections in the commutator or to difference in the structure of the pole-pieces, can generally be determined by the effect of smoothing the commutator. If the trouble is with the poles, the sparking will be reduced temporarily, in consequence of the smoother surface, but if it is due to unequal wear of the commutator segments or insulation, the beneficial effects of the smoothing will be far more lasting, but not by any means permanent.

From the foregoing we can see that there are so many causes that tend to vary the actions of machines that the wonder is that they are so nearly uniform. If all the points in which a difference can exist could be made to act in one machine negatively and in another positively, the difference in the performance of the two might be 20 or 25 per cent., and possibly more, but such conditions never prevail. A difference that may be positive in one will be negative in another, therefore one neutralizes the other, and the actual difference between machines is equal to the difference between the sums of the actions. The dissimilarity of action that we would be made to believe is an incomprehensible mystery, as can be seen from the foregoing, is very far from being such, and the results that mystery-seekers assume should be obtained can only be realized by chance.

Principles of Electrical Distribution.—X.

BY FRANCIS B. CROCKER.

DIRECT CURRENT CONVERTERS.

THE fact that electrical energy can be readily transformed from a higher to a lower voltage, or vice versa, constitutes one of its most important advantages, and enables it to be conveniently and economically transmitted and distributed. The most prominent example of this method is the ordinary alternating current system, in which a high pressure of a thousand volts, or more, generated by the dynamos, may be carried by small wires to a considerable distance, and there transformed to a low voltage that is harmless to persons and adapted to supply lamps, etc.

The direct current can also be transmitted in a similar manner, but it requires rotary converters instead of the simple static transformers which are used for the alternating current.

Rotary converters may be described as consisting of a combination of a motor and a dynamo, the former being driven by the current from the main or *primary circuit*, and the latter generating the current for the *secondary circuit*, by which the lamps, etc., are supplied. It is obvious that the dynamo may be designed to produce any desired voltage without regard to that of the primary circuit. But in every case the watts—product of the volts and amperes—are less in the secondary circuit by an amount corresponding to the frictional and other losses which necessarily occur. This device has been given many names, such as dynamotor, motor-dynamo, motor-transformer, rotary-transformer, motor-converter and rotary converter. The first of these has the advantage of being a single word, but has been objected to because the order in which the two machines work is inverted, hence the second name is more often used, although less euphonious. The word transformer has been almost universally adopted for the induction coil or static transformer, so that the term converter, which was formerly applied to this device, is now free to be used for the rotary or motor-converter. There is certainly no advantage in having two names used indiscriminately for two different things; whereas it would be convenient and avoid confusion if they were employed respectively in the manner here suggested.

In many instances the two armature windings are placed on the same core and are acted upon by the same field magnet. This construction secures compactness and also causes the armature reaction of the dynamo to practically neutralize that of the motor, thereby avoiding sparking and other troubles. But it is open to the objection that it is somewhat difficult to insulate the two windings from each other, and absolutely prevent the high voltage of one from breaking through to the other. Therefore, this arrangement is not desirable where there are great differences in potential between the primary and secondary circuits, unless special precautions are taken. Another limitation of this construction is the difficulty of acting on the two armature windings independently for purposes of regulation. Since both are wound upon the same core and are under the influence of the same field, it is hardly possible to change the speed, magnetic flux or other conditions of one with respect to the other. In other words, the ratio of conversion, that is, the relation between the primary and secondary voltages, is practically constant, no matter how much the speed or flux may be varied. To be sure, the difference of potential between the secondary brushes may be decreased by introducing resistance in the primary circuit, but this merely has the effect of reducing the available voltage supplied to the motor. The amount of this reduction is the drop—IR, in which I is the primary current and R the resistance, a corresponding decrease in voltage being produced in the secondary circuit, but the ratio of conversion remaining substantially unchanged. Resistance put in the secondary circuit will have a similar effect in decreasing the available potential, but in either case the loss of energy is considerable, its value in watts being I^2R. The so-called "regulation" is also seriously interfered with; that is, the available secondary voltage varies greatly with changes in the load, because any alteration in the current has a corresponding effect on the drop IR. Such a variation in pressure would usually be very objectionable; in electric lighting, for example, the voltage would fall as more lamps were added in parallel.

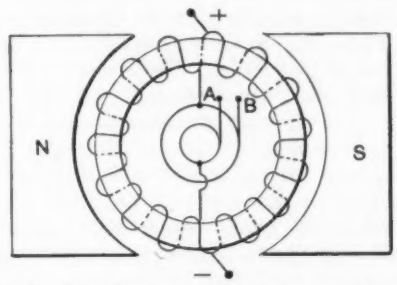


FIG. 38.—DIRECT-ALTERNATING CURRENT CONVERTER.

In order to secure independence of action between the motor and the dynamo portions of a rotary converter, the two armature windings are carried by separate cores, each being acted upon by its own field magnet. This allows the field of the dynamo to be independently regulated, in order to vary the voltage generated. In fact, any of the well-known methods of dynamo regulation may be employed. For example, compound or over-compound winding will give a constant or a rising pressure, with increase of current in the secondary circuit. In these cases, the separate armatures may be mounted upon the same shaft, with only one pair of bearings, in order to combine the two parts in one machine, or two entirely distinct machines may be connected directly or by belting.

It is evident that the motor of a rotary converter may be designed to operate with an alternating current, and the dynamo to generate a direct current, or vice versa, in order to convert alternating to direct currents, or the converse.

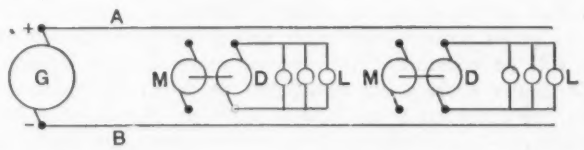


FIG. 39.—DISTRIBUTION BY ROTARY CONVERTERS IN PARALLEL.

Another type of a rotary converter is that in which the same armature winding performs both the motor and dynamo functions. A simple form of this machine, shown in Fig. 38, consists of a gramme ring armature, diametrically opposite points of the winding being respectively connected to two collecting rings. When the armature is supplied with direct current in the usual way by the brushes + and —, it will revolve as a motor, and an alternating current may be obtained from the brushes A and B. This action can be easily understood when it is considered that the outer collecting ring is connected to the top or + point of the winding and the inner ring to the bottom or — point of the winding, hence the current tends to flow from the brush B to the brush A; but when the armature has turned through 180 degrees, or half a revolution,

these conditions will be exactly reversed, and the current tends to flow from *A* to *B*. Thus it is seen that an armature having only a single winding may be fed with a direct current, and will give out an alternating current. The ratio between the primary and secondary voltages is practically fixed in this form of converter, since the maximum value of the alternating E. M. F. is equal to the voltage of the direct current, as is evident from the diagram. With a true sine wave the effective value of the alternating E. M. F. is 0.707 of the direct E. M. F.

If these machines are used to convert alternating to direct current, they are run as synchronous motors; hence they must first be brought up in speed by some extraneous power until they are in synchronism with the alternating current by which they are to be operated.

Rotary Converter Systems of Distribution.—The usual arrangement of rotary converters in electrical distribution is that represented in Fig. 39, being analogous to the ordinary alternating current system with static transformers. The current produced by the main generator *G* is carried to the converters by the conductors *A* and *B*, to which the motor portions *M* of the rotary converters are connected in parallel. These motors are provided with shunt wound field coils, consequently they run at a practically constant speed. The dynamo portions *D* of the converters are connected to the secondary circuits which supply the lamps, etc., *L*, as indicated. This system has several disadvantages compared with the alternating current system. Rotary converters are more complicated, cost more, require more attention and are less efficient than static transformers. But it has been shown that they may be compound or over-compound wound, in order to supply a uniform voltage, which is not practicable with static transformers. Furthermore, it is generally found that rotary converters are easily taken care of and rarely get out of order. In many cases their use may be desirable or necessary, as, for example, in electrochemical or electrometallurgical work, in connection with storage batteries, or for many purposes where it is required to convert direct currents to a higher or lower pressure.

Rotary converters may also be arranged as illustrated in Fig. 40, the motor parts *M* being all connected in series with the main generator *G*, and the dynamo parts *D* of the converters being connected to the lamps, etc., *L*. If the current is kept constant (the generator *G* having a regulator like an arc lighting dynamo), and the motors *M* are simple series

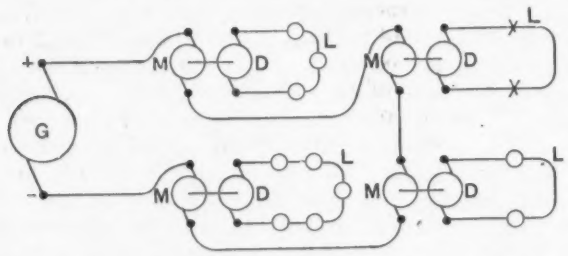


Fig. 40.—Distribution by Rotary Converters in Service.

wound machines, they will exert a certain torque or turning effort which will be constant. It follows, therefore, if the dynamos *D* are also series wound, that each will generate a certain current which will be constant. If lamps or other devices designed for that particular current are connected in series on the secondary circuits, the dynamos *D* will always maintain that current, no matter how many lamps there may be. When lamps are added the resistance of the local circuit is raised and the current in it decreases, so that the dynamo increases its speed until it generates sufficient E. M. F. to produce practically the same current as before. Hence this constitutes a system which is self-regulating, when lamps, etc., are cut in or out of the secondary circuits. No harm results even when the secondary is short-circuited, since only the normal current can be generated. But if the secondary circuit is opened, then the machine will race and probably injure itself by centrifugal force, because the torque of the motor *M* has its full value, and there is no load upon the dynamo *D*. To guard against this danger, some automatic device should be provided to short-circuit the field or armature of the motor when its speed or counter E. M. F. rises above a certain point. Another way to operate such a system would be to use motors *M* with governors which maintain a constant speed for all loads, in which case the dynamos *D* should be shunt or compound wound, to feed lamps, etc., in parallel at constant potential.

The Third Annual Cycle Exhibition at the Grand Central Palace, New York City.

Imagine a great metropolitan structure, with nearly 200,000 square feet of floor space practically covered by the display of some 500 exhibitors of cycling appliances and materials of every conceivable nature and description, available either in the manufacture or used in the modern bicycle. Add to this a brilliant display of electrical illuminating and decorative effects, serving as an almost indispensable aid in increasing the attractiveness of the actual exhibition, and you have a fair idea of the recently ended third annual cycle show held at the Grand Central Palace, 43d Street and Lexington Avenue, New York City.

This exhibition lasted one week, commencing Saturday, Feb. 6, and ending Saturday, Feb. 13, and included anything which could in any manner be connected with the bicycle and its transition from the raw steel tube to the perfect modern "safety," and all accessories and sundries intended to bring additional comfort and safety to the cycler.

The array of modern safety bicycles was imposing and amazing, including all sizes from the small juvenile wheels to a monster exhibition wheel some 15 feet in height; wheels intended for one, two, three or six persons, finished and colored to suit almost any taste, from the ordinary black enameled affair to the $10,000 gold and diamond trimmed tandem displayed by one manufacturer. Aside from the general details of construction—and each concern most emphatically claimed to have the best—but very little difference existed between the various wheels in general outline. Novelties, certainly, were shown, but they were in the minority. Amongst these were some new frame constructions, folding frame bicycles, chainless drives, in which bevel or spur gears were substituted for the chain, multi-speed gears, gear cases and electric and gas bicycle lamps. The array of accessories or sundries was almost unlimited, in fact, too numerous and variegated to be even considered here. It seemed as if the whole world were at work for the benefit of cycledom.

One could not fail to be impressed with the greatness of this show, as from a quantitative point of view there was certainly enough, if not too much, to see. Bicycles, however, were not the only exhibits which attracted attention and elicited praise from the visitors. Electricity was called upon to give attractiveness to the exhibits, and it was a question with many whether the display of bicycles or the electrical effects and decorations were worthy of the more praise. It would, however, be entirely modest to say that the latter were by far not the least attractive feature of the show. Almost every exhibitor availed himself of the opportunity of adding an electric sign to his display. Such signs and similar displays were unlimited, which added to the central pagoda or pavilion of the National Board of Trade of Cycle Manufacturers, and the ordinary lighting of the building produced an electrical illumination and decorative effect not even exceeded at the recent Electrical Exposition.

The regular isolated plant located in the building was entirely incapable of furnishing the immense amount of current necessary for the purpose. The electrical part of this plant consists of three bipolar Edison 110-volt dynamos, each of 45 kw capacity, and two multipolar Wenstrom Fort Wayne 110-volt dynamos of 70 kw each. The maximum output of this entire plant is about 5000 16cp. lamp equivalents. In addition to this it was necessary to provide current for the extra lighting for signs and exhibition booths, which amounted to about 6600 15-cp lamps and about 9300 miniature lamps ranging from 1 to 8 cp. About 1500 lamps, of which about 100 were 16 cp, were used in addition to the above for lighting and decorating the central pavilion. In order to take care of this special exhibition lighting, a temporary plant was installed at the 26th Street station of the United Electric Light and Power Company, and from this plant a special feeder was run to the Grand Central Palace, carrying about 150 amperes at about 2900 volts. This feeder supplied current to a bank of transformers at the building, where the voltage was reduced to about 110 volts secondary, with approximately 4000 amperes. The current used for lighting and decoration was between six and seven thousand amperes.

The distribution in the building covered the entire four floors from 14 centres of distribution, necessitating 11 pairs of No. 0000 B. & S. and three pairs 300,000 circular mils feeders, which were run to the bank of transformers in the basement. These feeders ran to the centre of as many mains, all of which were either No. 00 or No. 0 B. & S. wire, run so as to pass over every booth in which special or sign lighting was to be used. About 500 tap connections to the

various booths were made, each tap being made through a separate branch cutout and switch. All wiring was on the two-wire system, and figured so as to give a uniform drop of about 4 volts. The load on the various feeders was distributed so that each carried about 250 amperes. This entire temporary construction was overhead openwork, tied to cleats, which were fastened to the girders with girder hooks. The rapidity with which this work was carried on and its excellent character are particularly notable. All mains and feeders throughout the building were installed in three days, and the connections to the various booths were all finished between Friday morning and Saturday at 6 P. M. Every exhibitor whose order was in for lighting on Friday, Feb. 5, had his signs and devices placed in position and connected, ready for the opening night.

The pagoda or pavilion in the centre of the main floor formed a very brilliant example of electric decorative lighting. It was practically an open pavilion, in the centre of which was placed an exhibition case displaying various cycling trophies. Around the edge of the circular pavilion a number of massive pillars supported a dome-like roof, on top of which were various superstructures, giving the entire pavilion the character of a pagoda. The roof or dome was entirely surrounded by a circular electric sign, and the upper structure was decorated with a number of bicycles and revolving wheels studded with miniature lamps. The latter were constantly revolving, being operated by a Lundell alternating-current motor, producing a very novel effect. The entire work on this pavilion was done between the hours of 7 P. M. Sunday and 8 A. M. Monday.

The general electrical work was under the supervision of Messrs. Pattison Brothers, 136 Cortlandt Street, New York, as consulting engineers. The actual installation and construction was entirely supervised by Mr. Marcus Nathan, the official electrician of the Grand Central Palace, who also installed all the wiring and a large number of the electric signs and decorative effects, including those on the above-mentioned pagoda.

Many of the signs and electrical decorative effects were supplied complete, some of them having been used elsewhere. A large number, however, were constructed and wired on the premises. Among those who built some of the more prominent of these signs are the Empire Sign Company of New York City; Edison Decorative Lamp Company, Harrison, N. J.; Mr. Marcus Nathan and Mr. Frank Martin, electrician of the Madison Square Garden. Many of these signs were supplied with commutating devices for automatically changing the lights and producing novel effects, some of which were very ingenious. This necessitated the use of about 100 motors, ranging in size from ⅛ to 2 hp.

Amongst the very largest signs at the exhibition were those of the Spalding Company, in which some 1200 miniature lamps from 3 to 8-cp were used; the Western Wheel Works sign, using the same number of similar lamps; the Syracuse Bicycle Company's sign, with some 400 16-cp lamps; the Columbia Bicycle Company's sign, the American Wheelmen's sign, the Monarch Wheel Company's sign, the Liberty wheel sign, and Barnes' "White Flyer" sign.

Electrical apparatus was also not absent from the general exhibits. Several very ingenious electric bicycle lamps, using electricity or a product of electricity, were exhibited, and attracted a great deal of attention. These will be found described elsewhere in this issue. The Zucker, Levitt & Loeb Company, New York, had a very interesting exhibit of electric plating apparatus.

There were also several exhibits by concerns well known in the electrical world of tools and appliances used in bicycle manufacture. Among these concerns were the Garvin Machine Company, the Pratt & Whitney Company, the Frasse Company, A. L. Moore Company, the E. P. Gleason Manufacturing Company, the Yale & Towne Manufacturing Company, Niles Tool Works Company, H. G. Barr & Co., and the Ferracute Machine Company, all of which either have offices or are located in this city, the Billings & Spencer Company, Hartford, Conn.; the Standard Tool Company, Cleveland, O.; the Builders' Iron Foundry, Providence, R. I., and the United States Projectile Company, Brooklyn, N. Y.

The above concerns showed a variety of lathes, tools, drills, presses, etc., used for bicycle making, many of which were, however, of equal interest to the electrically inclined visitor. A great many rubber companies exhibited, among which were the New York Belting and Packing Company, the Mechanical Rubber Company and the Akron Rubber Company.

Blow lamps for brazing or soldering purposes, using either kerosene, naphtha, or gasoline as fuel, were shown by the Primus Cooking and Heating Apparatus Company and the Turner Brass Works of Chicago.

The show was certainly an immense attraction, and included a vast amount of interesting material even to those who have no personal interest in wheeling.

The Paris Exposition of 1900.

Hon. Samuel E. Morss, United States Consul-General at Paris, has transmitted to the State Department a very complete report on the International Exposition, to be held in that city in 1900. The report not only sets forth the general scope and character of the exposition, its organization, financial arrangements and the special features by which it will be characterized, but it gives in detail the systems of classification and awards adopted and all the regulations affecting foreign exhibitors. This exposition, Mr. Morss asserts, will no doubt afford unequalled opportunities to make known to the world the resources of the United States and their achievements and facilities in the various fields of production, and he states that, judging from the number of inquiries already received regarding the exposition, a widespread interest in it exists in the United States.

The exposition will be opened on April 15 and will close Nov. 5, 1900. The site will comprise the public grounds on both sides of the River Seine from the Place de la Concorde, the great monumental square, in the centre of the city, to a point beyond the Pont d'Jèna, embracing the Champs de Mars, the Trocadèro Palace and Park (site of the exposition of 1889), Quai d'Orsay de le Conference, Cour la Reine, and a large section of the Champs Elysèes, including the site of the Palais de l'Industrie, and the great building erected for the International Exposition of 1855, the first of the series. This site leaves nothing to be desired in point of convenience and accessibility. All the details of architecture are not yet worked out. The Palace of the Trocadèro will be used, as well as several of the great exposition halls of 1889 in the Champs de Mars, and all of them will undergo more or less modification. The Eiffel Tower will be preserved, but it is probable that some new and striking features will be added. A magnificent edifice to serve as the Fine Arts Hall will be erected, to remain a permanent monument. The Hall of Liberal Arts will also be a stately and permanent structure. Between these great buildings will be erected a broad avenue from the Champs Elysèes to the Seine. The work of demolition of the buildings which are to give way to the new structures has already been commenced.

The national and municipal authorities and the management of the exposition will co-operate in improving the transportation facilities and public conveniences of Paris and in adding, before 1900, to the numerous attractions of the city. A number of modern hotels and several handsome new theatres will be built, and public parks, gardens and squares will be created in all parts of the city. At night the city will be brilliantly illuminated by an extensive system of electric lights, and it is the avowed purpose to make the exposition surpass all its predecessors both in France and elsewhere, not perhaps in extent or in architectural features, but in its artistic aspects and logical, comprehensive and scientific system of classification and award, and in the uniformity and harmony of the whole.

Consul Morss describes the financial arrangements and general regulations of the exposition, and the principal regulations as to the admission of exhibits. The tariff duties and other taxes are very liberal as regards foreign exhibitors.

The exposition grounds are constituted a bonded warehouse. All foreign products will be taken in charge at the exposition grounds by a special customs agent, and if finally entered for consumption will be subjected only to the duties imposed upon like products of the most favored nation.

All works and products exhibited will be passed upon, as in 1889, by an international jury, which will have three degrees of jurisdiction—jury of class, jury of group and superior jury. The distribution of awards will take place on or about Sept. 1, 1900. Only diplomas will be granted as recompenses. They will be classified as follows: Grand prize diplomas, gold medal diplomas, silver medal diplomas, bronze medal diplomas and honorable mention diplomas.

In the classification of exhibits electricity will constitute group No. 5, and is subdivided as follows: Production and mechanical utilization of electricity; chemical electricity, electric lighting, telegraphy and telephones, different applications of electricity. Railroad and tramway construction will come under the civil engineering and transportation group.

Some Dielectrics and their Insulating Properties.

To the Editor of the Electrical World.

Sir: The article of Mr. George T. Hanchett bearing the above title and published in your issue of Feb. 6 has been of much interest to me, since it bears very directly upon a line of work which has engaged a large part of my attention for some months past. A few points which suggest themselves to me may be of interest. Mr. Hanchett evidently considers the rigid insulation, if I may call it so, *i. e.*, the hard rubber or glass tube about the primary, the separating partitions between sections, etc., of an induction coil a matter of considerable importance; of as much perhaps, or even more, than the more yielding *composition* dielectric—paraffin, or whatever it may be—in which the various sections are usually imbedded. This opinion is generally held, I believe, and was my own until quite recently. My present convictions, however, based upon the actual construction of a large number of coils, most of them from 8-inch to 12-inch spark length, is that this is not the case; at any rate, *should* not be the case; *is* not, when coils are built with any regard to economy of space and material. In all coils which have been developed by my associates and myself, reliance is placed not at all upon the rubber tubes surrounding the primary, but solely upon the insulating composition which we mould about the secondary sections. We continue to use, it is true, the hard rubber tube, but chiefly because it is a convenient feature of the framework which lends itself nicely to finish. Were it not for the electromagnetic and electrostatic effects, I should feel almost as safe with a metal tube. As to separators between sections, we use only paper, free from carbon, well dried, and thoroughly saturated with the insulating composition. When the coil is finished I have between the primary rubber tube and the secondary proper a tube of insulating composition, and this, if maintained intact, I find to have many times the dielectric strength of the rubber. Indeed, I have found that in every case, if a secondary section manages to slip down so as to touch the rubber tube, the latter is ruptured instantly.

Paraffin has, indeed, some serious faults, as Mr. Hanchett says. So serious, indeed, as to make its use absolutely fatal to the permanence of the coil. Its tendency to crack and absorb moisture is one which Mr. Hanchett does not mention. Another, and perhaps the most serious of all, is its corrosive action on the wire due to free acid, this corrosion ultimately causing deterioration of the whole mass of paraffin.

I do not believe with Mr. Hanchett that an "easily melted material that will cool in a mould without blowholes or flakes" would entirely meet the need for a substitute for paraffin. A substance melting *with difficulty*, not *with ease*, is required, for since in continuous use we must provide for considerable heating of the secondary. Further, we do not get rid of the air, even if we do cool without blowholes, and air, after all, is the fatal element of weakness in most coils.

The ideal requirements for a mouldable dielectric in induction coils are, I think:

1. High melting point and high specific heat, thus retaining the sections at all temperatures and allowing the coil to be made small and compact, while yet providing for large dissipation of energy in the secondary.
2. Slight viscosity at all temperatures, thus avoiding cracking.
3. Small coefficient of expansion with temperature; this implies cooling without contraction, of course.
4. An exclusion of the air from the cooled secondary.
5. Permanent physical characteristics and no injurious action upon the wire.
6. Cheapness.

All these points are secured in a very high degree by an insulation composition which we have experimentally developed, and one of the principal bases of which is pure beeswax.

We employ a regularly organized process of assembling and insulating the secondary, a method resulting from a very large amount of careful experimentation, and the details of which, for obvious reasons, I do not care to publish. Suffice it to say that it is a method which permits of very complete removal of all air. How effective this process is may be seen from the fact that our secondaries are usually considerably shorter than the sparking capacity of the coil, and that we require but three-fourths of a pound of No. 34 B. & S. per inch of spark. The actual dimensions of a 12-inch secondary are, *e. g.* (the volume occupied by wire only being considered), mean internal diameter 4½ inches; mean external diameter, 5¾ inches; length, 10 inches; weight, 9 pounds, No. 34 B. & S.

The sparks produced by such a coil are solid and heavy, and may be made almost flames by using sufficient primary current.

We have for some time past found it practically impossible to break down any of these coils, with any amount of primary induction and any type of circuit-breaker, no matter how sudden the break may be. I might say also that general dimensions of coils thus made are but little larger than the oil insulated coil upon the market, and are fully as efficient and safe in operation, while doing away with all the very numerous disadvantages of oil coils, not the least of which is the dirtiness of all fluid insulators.

Elmer G. Willyoung.

Philadelphia, Pa.

Independent Telephone Interests in Indiana.

The Indiana Telephone Association held its first annual meeting on Feb. 4 at the Commercial Club, Indianapolis, Ind. Forty-nine of the sixty-five independent companies, constituting the membership of the association, were represented. The reports of the president, treasurer and secretary showed the association to be in a healthy condition, and the officers elected for the ensuing year are: President, E. M. Andrus, Lafayette, Ind.; vice-president, J. L. Stone, Rushville, Ind.; secretary and treasurer, A. E. Reynolds, Crawfordsville, Ind. Last year's board of directors and executive committee were re-elected. A committee of nine was appointed to confer with a joint committee of the Senate and House regarding a desired amendment to the anti-trust bill. This committee will report at a later meeting of the association, at which the committee on the revision of the constitution and by-laws will also report.

According to President Andrus, the association represents an investment in telephone plants to the value of $1,500,000. These plants are in towns and cities in the State of Indiana, and are said to be working admirably and giving perfect satisfaction at rates which, in many instances, are less than half those charged by the Bell Telephone Company.

The American Electric Telephone Company of Kokomo, Ind., had an extensive exhibit of many of its products, under the charge of Mr. P. C. Burns, the general manager of the company. The exhibit included long and short distance telephones, switchboards and magnetos, and was the centre of attraction and interest.

The association was organized in Indianapolis early in January, 1896, for the purpose of securing for its members a fair chance for competition in all the cities of the State with the Bell Telephone Company through municipal and State legislation.

Electricity on the New York Elevated Roads.

Mr. W. J. Fransioli, general manager of the Manhattan Railway Company, New York, has just returned from Chicago, after inspecting the electric system of propulsion now in operation on some of the elevated roads in that city. Mr. Fransioli was favorably impressed with what he saw, and on his return to New York made a report to the Executive Committee of the Manhattan Railway Company that was wholly favorable to the electric system.

The daily papers on Feb. 18, in reporting the subject, stated that the Executive Committee of the Manhattan Company had decided to give the system a trial on the New York lines, beginning with the Second Avenue road. This statement, however, Mr. Fransioli informs us, is not correct. The Executive Committee has taken no action whatever in the premises; it has simply received Mr. Fransioli's report, which is a favorable one to the electric system, as already stated. It is therefore premature to state at this time, in the absence of any official action by the Executive Committee, what course will be pursued.

Ingenious System of Lighting Gas Jets.

The famous Victor Emmanuel gallery at Milan is lighted in the evenings with rows of many hundred gas jets placed near the top, and the method of igniting these was an important question. It was finally solved by using a miniature electric locomotive running on a track passing close to the burners. This locomotive carries an alcohol torch, and is made to run rapidly over the whole circuit after the gas has been turned on.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY

CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Dynamo for Three-Wire System. ETTINGSHAUSEN. *Zeit. f. Elek.*, Feb. 1.—An article of some length, in which he describes and discusses analytically an arrangement suggested by Pichler, and gives the data obtained from an experimental model; the paper is largely analytical in character, discussing the theory of the arrangement. The armature is a gramme ring, which, besides the usual winding, has an additional one of thin wire, called an auxiliary winding, which has only half as much active wire as the main winding; for a two-pole machine the ends of this auxiliary winding are connected to two diametrically opposite points on the main winding, and the middle point of the auxiliary winding is led to an insulated contact ring with which the neutral brush is connected; the two halves of the auxiliary winding are thereby connected in series, so that the E. M. Fs. generated in them are added together; the E. M. F. developed therein will be alternating, the maximum value of it being equal to that in the main winding; the maximum will be generated when the ends connected with the main winding are in the neutral zone; when they pass through the magnetic axes there will be no E. M. F. in the auxiliary winding; it differs from the somewhat similar arrangement suggested some time ago by Dobrowolsky, in which it is the self-induction of an auxiliary coil which prevents the alternating voltages in the armature from sending a current through it, while in the present arrangement it is the E. M. F. of the auxiliary winding which at every moment is opposed to that generated at the two points of the main winding where the auxiliary is connected. The results of some tests with the improvised model are given. It may also be used as a booster, the current being led in from the neutral and one of the other brushes, and led out from the neutral and the other; one-half of the machine can also be used as a motor and the other as a generator.

Dynamo for the Three-Wire System. ROTHERT. *Elek. Zeit.*, Jan. 28.—An abstract of a recent paper, in which he discusses the various systems which have been proposed, and describes in detail the one originally suggested by Kingdon and recently improved by Mueller and Dettmar, an illustrated description of which was recently given in THE ELECTRICAL WORLD; the present paper does not seem to contain anything new.

Condensers in the Armatures of Non-Synchronous Motors. GUILBERT. *L'Eclairage Elec.*, Jan. 30.—An article of a theoretical nature discussing graphically and analytically the theoretical explanation of the results obtained with the Hutin and Leblanc system. He shows that the introduction of condensers in the armature of non-synchronous motors enables one to increase the torque and the cosine of the angle of lag of the motor; the same method which he uses can be applied to any given motor; in general this application of the condenser can be made only to motors having a small slippage, that is, a high efficiency.

Armature Reaction and Magnetic Distersion in Dynamos.—Elek. Zeit., Jan. 21 and 28.—A continuation of the long discussion: the former issue contains a short communication by Kando answering the criticism of Rothert and denying the correctness of it; the latter issue contains a communication by Heyland and another by Rothert; a note from the editors states that this lengthy discussion is now closed, as no new matter has been brought forward.

Speed Control for Electric Motors. BLOOD. *Elec. Eng.*, Feb. 3.—A short statement showing that the device suggested by Prof. Anthony, see Digest, Dec. 26, is a very old one; references are given to a number of United States and foreign patents. The issue of Feb. 10 contains a reply by Anthony, in which he shows that the reference cited by Blood do not show the same method; in one of the references cited the method is totally unlike in principle and results, which differences he describes; his application passed through the patent office without any question as to novelty.

LIGHTS AND LIGHTING.

Application of the Electric Light to Coast Defense. BOYD. Lond. *Elec.* and *Elec. Rev.*, Feb. 5; a short abstract of a recent lecture. — Small vessels could be distinguished in the concentrated beam 3,000 to 4,000 yards distant, and in the 16 deg. dispersed beam at 1,500 to 2,000 yards; the brilliancy was of great value, but the area of illumination is very small, and the dispersed beam is, therefore, preferred; "the typical defense of a large military port would be a scheme of concentrated search-lights, in an advanced position, 16 deg. dispersed beams behind, in connection with the mine fields, with possibly 30 deg. beams commanding any narrow passages or boom obstructions." He reviews the periodical practice carried out at the principal ports during the past 16 years; the results seem to show that a satisfactory state of efficiency has been achieved in the apparatus for the production of the light, but guiding principles should be laid down in regard to the organization of coast defences, in order to meet the changes in the probable form of attack; the Needles passages can be so illuminated as to make it practically impossible for vessels to pass without being seen; certain other results show that under the conditions of the trials, the weather being rough and misty, the vessels could not enter without being seen, but the average time a vessel remains under fire from one point was only from 1 to 1.5 minutes.

Three Arc Lamps on 110 Volt Circuit.—L'Ind. Elec., Jan. 25.—A note stating that Hegner has devised a very ingenious arrangement to overcome the difficulty encountered in running three arc lamps, in series on 110-volt circuits, and without the usual loss of 30 to 35 per centum of the power in the dead resistance; a description of this system is promised as soon as the patents can be properly applied for.

Incandescent Lamp Filament.—See abstract under Electro-Physics, on transition of carbon from the non-conducting to the conducting condition.

Light ELLIOT. *Elec. Eng.*, Feb. 10.—A continuation of the reprint of his recent paper (see Digest last week). He discusses the subject of distribution, but appears to give nothing new.

POWER.

Electrical Energy in Gold Mines—L'Elec., Jan. 30—A few details of the installation of the Rand Central Electric Company, in South Africa, which furnishes electrical energy to various mines. There are four steam engines, of a total capacity of 4000 hp; there are four three-phase dynamos, generating 700 volts, which is raised to 10,000 by transformers; this is transformed down to 250 or 500 volts for the motors; some of the mines are located 20 to 25 miles from the station.

10,000 Volt Transmission Plant at Eichdorf. Lond. *Elec*, Feb. 5.—An abstract of some length, with a number of the illustrations of the description noticed in the *Digest* Nov. 28.

Electric Power in Workshops. SCOTT. Lond. *Elec. Eng.*, Feb. 5.—A continuation of his illustrated articles on the local distribution of electrical power in workshops, in which he gives illustrated descriptions of various forms of motors, some of which are portable.

Electric Pumps.—L'Ind. Elec., Jan. 25.—An illustrated description of the system of Siemens & Halske, including illustrations of installation at the Ashio mines, in Japan.

Equivalents of Gaseous and Electrical Energy. L'Elec., Feb. 6.—A reprint from a German paper of some equivalents in luminous mechanical and calorific energy, of gas and of electricity.

Portable Electrical Drilling Machine.— Sc. Amer., Feb. 12.—An illustrated description of the drill which has been used at the Trieste arsenal for over three years with great satisfaction; the motor is carried on a roller truck, and is connected with the drill by means of a jointed shaft.

TRACTION.

Locomotives for the Jungfrau Railway. Elec. Anz., Feb. 4.—An extract from the competitive project for which a prize of $400 was awarded to the locomotive manufactory at Winterthur, Switzerland. The specifications called for a locomotive carrying 30 passengers and a trailer for 50; the power is estimated at 250 hp, which is to be divided between two motors, having a double reduction and engaging with the rack; the project is based on the three-phase system (see above); there are to be provided four different methods of braking.

Jungfrau Railway. WUEST and THORMANN. *Elek. Anz.* Jan. 21 and 28.—An extract of some length from the project which these engineers of the Oerlikon Company offered for the prize of $800, which prize they received; they prepared a project for both continuous and three-phase current for operating this mountain railway, and in the present extract the two projects are compared with each other. Regarding the regulation of the motors, they state that the continuous current series motors have the property to adapt the speed to the load without artificial regulation, while the three-phase motors maintain a constant speed; on such a mountain line on which great and prolonged changes of speed are not required, this feature is not against the three-phase motors; in the starting effort at full load the three-phase motors have the advantage of simpler construction and the absence of commutators; in the line construction the continuous current has the advantage of simplicity, as there are only two circuits, instead of three, which is of special importance at the switches (in the continuous current project they have evidently provided for rotary transformers, owing to the great distance); for the three-phase project, the transformers have the great advantage of requiring no attendance, and in the simplification of the transformer stations; electric braking is applicable in both systems, in the three-phase in conjunction with accumulators to make the braking independent of current from the line; the three-phase current has the great advantage that it is impossible to increase the speed on down-grades and that the speed on such grades is entirely independent of the attention of the motor man; three independent forms of brakes can be used with the three-phase system; the efficiency of the three-phase transmission is greater. The first cost of both projects has been worked out carefully by them, and, although the line loss was greater for the continuous current system, the first cost was considerably greater; for

300 passengers traveling upwards at the same time, the first cost for the continuous current system is 3160 francs, and for the three-phase current 2030, besides which the transformer stations are more expensive for the former. In the capacities of the two systems, the continuous current has the advantage that the density of traffic is not so limited, for with the three-phase current the interval between two transformer stations must be kept the same, the momentary output for the continuous current system would, therefore, be increased; on the other hand, the increase in the number of transformer stations can be accomplished at less cost for the three-phase system. In conclusion, they state that, considering everything, the three-phase system is decidedly the preferable one. They then discuss the power station for the three-phase system, giving some of the figures, including the lighting and heating of the cars and the stations on the mountains. In the second portion they discuss the advantages of electric transmission in constructing the numerous tunnels; they propose using 500 volts for the transmission and allowing 100 hp for each tunnel section; they show the advantages of using electric transmission over petroleum for the construction of these tunnels; the latter would have to be transported, at great expense, to those great heights, the total quantity required being 2400 tons; the lines, boring machines, and plant for boring the tunnels, are briefly discussed.

Liverpool and City and South London Railways. Lond. Elec., Feb. 5; an editorial notice of the recent reports of these two companies for the past six months.—On the Liverpool line 320993 train miles were run, as against 313010 during the previous half year the 3919134 passengers represented an increase of 820441; the revenue per train mile rose from 23.9d to 24.5d; the ratio of expenditure to receipts rose from 63.2 to 63.8 per centum; the figures are considered decidedly satisfactory; of the total expenditure, 23.4 per centum, representing 3.6d per train mile, is traceable to the power station, which thus absorbs about 15 per centum of the receipts; coal and coke costs 0.52d per train mile, which is about 14 per centum of the power station expenditure and 3 per centum of the total expenditure. In a brief comparison with the cost of fuel in central stations, it is shown that under the best conditions yet attained in electric supply stations, a fuel economy can be arrived at equal to only about half of that obtainable in this power station. On the City and South London Railway during the same time 231489 train miles were run, carrying a total of 3368480 passengers; the rolling stock includes 46 cars and 17 locomotives; the receipts increased from 27d to 27.25d per train mile, and the total expenditure is 15.5d per train mile, making the ratio of expenditure to receipts 56.8 per centum, which is considered low for that class of railway; the capital outlay per mile of this underground line is about three times that on the Liverpool overhead line; the power station expenditure amounted to 5.65d per train mile, of which 1.52d was paid for fuel.

Electric Traction on the Bourgogne Canal. Dupuy. *L'Eclairage Elec.*, Jan. 30.—An extract from a recent book by that author, giving some figures regarding this canal, on which electric traction has been used for some years. From recent tests, canal boats drawing two meters of water and carrying 200 tons, at a speed of 2700 to 2800 meters per hour, the energy required is 2.1 to 2.4 kw hours, a mean of 1 kw hour per ton could, therefore, be taken for an average speed of 2.5 km per hour; the result is said to be very satisfactory.

Electric Propulsion of Vessels. Heilmann. *L'Eclairage Elec.*, Jan 30.—A note describing the application of the Heilmann system to large vessels, and stating that an experimental application will soon be made on the river Seine, from which practical results can be obtained. (In this system the propellers are driven by electric motors, which receive energy from generators driven by a steam engine and by means of which system certain advantages are secured over direct driving.)

Injurious Effects of Railway Circuits. Van Vloten. *L'Elec.*, Jan. 30.—A conclusion of the very long reprint which has been running through that journal for some time, and has been noticed frequently in these columns; in the present portion the English Board of Trade rules are discussed. The article appears to be a very thorough discussion of the subject of the evil effects of the earth return circuits.

Vienna Electric Railway. Lond. Elec., Feb. 5.—A short description of this line, the first started in that city; it was opened on Jan. 27; one of the features is that the span wires are in many cases connected to rosettes fixed to the buildings, poles being used only where they were absolutely necessary.

Bilbao. Elek. Zeit., Jan. 21.—A brief illustrated description of the passenger and freight line in this city in Spain.

Conduit System at Brussels. Pierard. *L'Elec.*, Feb. 6.—A very brief description with some illustrations of the conduit line in Brussles, in which the Thomson-Houston system is used; it is a six-mile double track road; the conduit seems to differ only in details from the usual forms; the construction appears to be quite simple; both conductors are insulated; the conduit is small, is mainly of concrete and is periodically cleaned with running water.

Electric Vehicles. Krieger System. London Elec. Rev., Feb. 5.—A translation in part, with one of the illustrations, of the article noticed in the Digest, Feb. 13.

Electrical Conductivity of Cement and Concrete. Sc. Am., Feb. 13.—A reprint from the *Lond. Elec. Rev.*, of the abstract of the recent paper by Lindeck, the original of which was noticed in the Digest, April 11, 1896.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Charging for Current at Brighton. Wright. *Lond. Elec. Rev.*, Feb. 5; a reprint of a short report.—The net profit made during the past year has probably greatly exceeded that of any previous year; the general use of electricity in that city is very much greater than in any other town in the United Kingdom, due to the judicious lowering of the tariff; the financial success of the system of charging used (the well-known Wright system) in that town, and the fact that 29 other towns have already decided to adopt it, is evidence of the soundness of the principles on which it is based. From last year's results, the only extra cost to which the corporation has been put in having to continue the supply of electricity after the plant, etc., has been got ready for the purpose, amounts to merely 1.25 cents per kw hour; in other words, supposing that each consumer paid the cost of getting ready to supply him, amounting to 0.5 cents per lamp per day demanded, and was then charged all the electricity consumed, at the rate of 1.5 cents per unit, there would have been a net profit of $5000; the present initial price of 14 cents for the first hour each day does not yet quite cover the cost of getting ready; he thinks that two million units will be sold in the next year; he strongly recommends to fix the charge for the low price unit at three cents, which will yield an adequate profit and will give a considerable impetus to the use of the current in private houses and for motors; it will reduce the cost for street lighting from 6.67 cents to 4 cents per unit and will reduce the average price for private houses and stores from 10 to 8 cents; this tariff after the first hour will make electricity as economical for power purposes and for cooking as the average gas engine or stove; it will enable a station to supply motor car batteries and the seashore railway, at an encouraging price, and will considerably reduce the expenses per unit, as it will still further diversify the classified consumers. (The committee recommended that the initial charge be 14 cents for an average of one lamp per day, as heretofore, and that the charge over such average shall be reduced from 6 to 3 cents per unit.)

Alternating Current Switchboard. Andrews. *Lond. Elec. Eng.*, Jan. 29; the beginning of a reprint of a recent paper.—In the present portion he calls attention to the interruptions which still occur and which, he thinks, may nearly all be prevented if more attention is given to the switchboard; too much reliance is placed on experienced attendants, instead of devising a switchboard so that mistakes cannot so readily be made; he thinks the result would be better if the attendant knows that it is not possible to make a mistake. With alternators in parallel he favors the suggestion to first switch them on to the circuit through a very light fuse; at his station at Hastings this idea has been made use of with the exception that a magnetic cut-out is used, instead of the fuse, as it is quicker in action and more easily reset; such a device has been in successful operation there during the past two years and it is now very rare that the cut-out is brought into action; a diagrammatic sketch of the arangement is given; the current from the generator passes through a solenoid to the outer bus bar, through the lamps to the inner bus bar, and back to the generator through the switch contacts; to switch on, the handle sets a weight closing some contacts, but the circuit is still interrupted; this weight is free to fall when closed; when approximate synchronism is thought to be reached the handle is pushed home, finally connecting the generator to the bus bars; if out of phase, the current from the bus bars will pass to the generator through the solenoid, thereby releasing the weight, which, in falling, freely increases its momentum, used to open the circuit. He has no hesitation in letting any one who has never seen machines paralleled before, synchronise with this arrangement. He then begins the discussion of the prevention of the failure of one set to affect the others working with it. In the conclusion in the issue of Feb. 5, he describes other apparatus used on the switchboard of that station; the descriptions cannot well be abstracted; among them is a description of a magnetic cut-out for protection against a return current. A high potential switch is described and illustrated, in which all the parts connected to the high continuous circuits are behind a marble board, where there is no danger of their being touched, which he considers an important point in the safe operation of the station; the switches pass through openings in the marble board; a change over switch operating automatically is also described. A reprint is begun in the Lond. Elec. Rev., Feb. 5.

Instrument Car of the Munich Station. Upperborn. *Eleck. Zeit.*, Jan. 21.—An illustrated description of the carriage or car used by this station for measuring and testing the underground circuits on the street. It is a departure from the usual forms, which are based on English practice, and in which the unsatisfactory Kelvin method of reading galvanometer deflections, is used; in the present form, devised by the writer, he uses the transparent scale; the carriage carries all the necessary instruments and batteries; the galvanometer rests on a tripod which projects through the bottom of the car, and rests on the street on levelling screws; the top of it has an additional levelling arrangement, like that on surveyors' instruments; a petroleum lamp is used as the source of light; there are 100 dry cells of batteries; the car contains a table with all the necessary instruments, switches, etc.; the illustrations are quite clear, and the description is given in great detail.

Insurance of Municipal Central Stations. Lond Elec., Feb. 5.—The discussion, apparently in full, of the paper by Pearson noticed in the Digest last week. The Lond. Elec. Rev. contains a brief abstract of the discussion.

Central Station Statistics for France. L'Ind. Elec., Jan. 25.—A 16-page supplement, containing tabulated information and statistics of the central stations in France up to January, 1897; it forms the seventh annual edition of this table; no analysis, totals, or conclusions are given.

WIRES, WIRING AND CONDUITS.

Wiring Accessories. Hundhausen. *Eleck. Zeit.*, Jan. 21.—The conclusion of a long illustrated paper, the first part of which was referred to in the Digest Feb. 6; a large number of illustrations are included. It is followed by the discussion.

Local Distribution at Niagara Falls—Elec. Eng., Feb. 10.—A short illustrated article, showing the interior of the cable bridge and of the local subway, also giving a map of the locations of the respective factories.

ELECTRO-PHYSICS AND MAGNETISM.

Transition of Carbon from the Non-Conducting to the Conducting Condition. BRION. LOND. *Elec.*, Feb. 5; a long translation in abstract from the Wied. Ann., 59 p. 715.—Graphitic carbons are conductors, but all carbon compounds, as also diamond, pure charcoal and coal, are non-conductors; all carbonized substances become conducting; in the present article he describes elaborate experiments made to investigate the transition from the non-conducting to the conducting condition. He used a number of different substances and measured them under various conditions; the method of measurement is described in detail and involved numerous difficulties; a curve is given, showing the progress of the conductivity at successively higher temperatures for a bamboo fibre and for one of cellulose; the transition into the conducting condition is exceedingly rapid. Filaments tested some time after heating show a surprising increase of resistance, and this is probably not due entirely to the occlusion of gases, but to an unstable condition of the carbon; the resistance approaches a limit, and a residual conductivity remains under any circumstances, which is smaller in proportion as the original temperature was lower; a set of experiments was made, in which the resistance at the high temperature was measured, and the results are given in curves; when exposed to a strong heat the filaments become better conductors in five minutes than with two hours' exposure at a lower red heat, prolonged heating at lower temperatures, therefore, cannot take the place of exposure to high temperatures. In his conclusions he states that the transition from non-conducting to conducting takes place with extraordinary rapidity, and in the same way for all the materials examined, but on cooling a relapse takes place, first rapidly and then slowly and may last for days or weeks, the relapse being more pronounced the lower the highest temperature; the resistance is a function of the highest temperature to which it was exposed, of the time elapsed since heating, and of the present temperature of the fibre; the differential co-efficient of resistance and the highest temperature decreases with increasing temperature and approaches the limit zero; the co-efficient between the temperature and the time elapsed since heating, decreases with the time and with an increasing highest temperature; the coefficient between the resistance and the present temperature, decreases with this temperature. Whether this involves a change of carbon into graphite, was not investigated, and it does not appear probable that there is such a change owing to the relapsing process, but a molecular transformation must be assumed, which gradually retrogrades again on cooling if the temperature was not high enough.

Internal Rays. OUDIN AND CORDA. Lond. *Elec.*, Feb. 5.—A short communication to the article by S. P. Thompson (see Digest, Jan. 23); the latter showed that the anti-cathode of a focus tube gives two kinds of rays behaving differently under the action of a magnet; the present writers repeated the experiment, but their results did not confirm the assertions of Thompson; they observed a decided deflection in each case, the amount of which depended on the distance from the screen to the tube; they therefore question the existence of new rays. In a reply, Thompson states that these experimenters have really confirmed his discovery of the internal rays which are capable of being deflected by the magnet, and are therefore not Rontgen rays; also that they claim to have deflected the Rontgen rays, which would be a startling discovery; he doubts their conclusions and questions the accuracy of their experiments; he also has observed an apparent deflection of the Rontgen rays by a magnet, but this was always traceable to the displacement of the focus point.

Low Temperature Research. Elek. Zeit., Jan. 28.—A short editoria calling attention to the industrial application of researches made at very low temperatures and referring briefly to the experiments of Fleming and Dewar; it is stated that owing to the ingenious invention of Dr. Linde (not described) liquid air and oxygen can now be produced by the quart at very slight cost; it is therefore possible now to make researches in any laboratory at any temperature down to 180 deg. C.

Capacity and Residual Charge of Dielectrics as Affected by Temperature and Time. HOPKINSON AND WILSON. *Lond. Elec. and Elec. Rev.*, Feb. 5.—A brief abstract of a recent Royal Society paper describing experiments, most of which were made with window glass and ice.

Polarization of the Electric Ray. BOSE. *Lond. Elec. Eng. and Elec. Rev.*, Feb. 5.—An abstract of a recent Royal Institution lecture; the lecture is also discussed editorially in the Lond. Elec.

Passage of Electric Waves Through Tubes. RAYLEIGH. *Phil. Mag.*, Feb.—A mathematical discussion in which he gives a solution of the problem when the bounding conductor is regarded as perfect.

High Vacuum Pressure Gauges. SUTHERLAND. *Phil. Mag.*, Feb.—A communication of considerable length, in which he discusses the subject of gauges, calculating the limitations of the McLeod gauge, and describes in a general way a disc viscosity meter and a tortional radiometer of special design. In his conclusions he states that there is strong evidence that in highly rarified gases in glass vessels there is always an unremoved trace of water which exercises a perturbing influence, increasing with the rarefaction and becoming serious at about a millionth of an atmosphere.

Application of the Radioscope for Diagnosing Diseases of the Thorax. BOUCHARD. *L'Ind. Elec.*, Jan. 25.—An abstract of an Academy paper in which he shows that there is a close agreement between the results of an examination of the thorax by the radioscope and by the method of percussion; the former shows even more.

X-Ray Fluorescence. RADIGUET. *Comptes Rendus*, No. 4; noticed briefly in the Lond. *Elec.*, Feb. 5.—He found that enamels, glass and porcelain exhibit fluorescence under the influence of X-Rays and recommends their use for screens; the images are not so bright, but may be "optically worked," show much more detail, and reduce the exposure for radiographs without producing granulation.

Experiments with Rontgen's Radiation. THRELFALL AND POLLOCK. *Proc. Lond. Phys. Soc.*, Jan.—The beginning of a reprint in full of their paper which was abstracted in the Digest Dec. 12; see also Dec. 26.

Formation of Penumbra in X-Ray Investigations. SAGNAC. *Lond. Elec.*, Jan. 29.—A translation of the French Academy paper which was abstracted in the Digest, Dec. 26.

Cathode Rays in an Electric or Magnetic Field. GARBASSO. *Proc. Lond. Phys. Soc.* Jan.; abstracted briefly from the *Rend. Acc. Linc.*, 5 2, 1895.—A theoretical article discussing the nature of the rays or waves.

Dielectrics in the Magnetic Field. DUANE. *L'Eclairage Elec.*, Jan. 30; abstracted from the *Wied. Ann.*, Vol. 58, p. 517.—A powerful magnetic field increases the damping of oscillations of a dielectric in certain positions with regard to the lines of force; the dielectric must rotate around an axis perpendicular to the lines of force; he endeavors to show the causes of this phenomena; it appears to be the same article which was noticed in the Digest Oct. 3; see also Aug. 15.

Magnetic Dip in Etruscan Times. FOLGHERAITER. *Proc. Lond. Phys. Soc.*, Jan.; abstracted briefly from the *Rend. Acc. Linc.*, 5, 2.—He endeavored to find the magnetic dip in central Italy at about the 8th century, B. C., by measuring the direction of magnetization of Etruscan pottery; he found that the dip was very small and may have changed from south to north about that time.

Hard and Soft Magnetic Bodies. KOHN. *L'Eclairage Elec.*, Jan. 30.—An abstract from the *Wied. Ann.*, 58, p. 527.—He describes experiments made to verify certain conclusions from the Foeppl theory of remnant magnetization; the article was abstracted briefly in the Digest, Oct. 24.

Energy of the Current. GROSS. *Elektrochem. Zeit.*, Feb. 1.—A mathematical article on energy, in which he attempts to develop a foundation for a theory of the energy of the current.

Effect of the Surface of Discharge Knobs. SWYNGEDAUW. *L'Ind. Elec.*, Jan. 25.—A reprint of the Academy note noticed in the Digest, Jan. 30.

New Fluorescent Salt. KOLLE. *Elec. Eng.*, Feb. 10.—He has experimented with the new salts introduced by Van Melckebeke in Antwerp, and has obtained very successful results; he thinks this salt, which is the oxyfluoride of uranium and ammonium, will probably replace both of the usual salts within a short time; he gives the formula for it and describes how it is prepared; "take one ounce of uranium nitrate c. p. (Merck's reagent), and allow it to dissolve in four ounces of water, which is brought to a boiling point in a porcelain evaporating dish, over a sand bath, using the Bunsen flame. The uranium will solve readily, leaving a straw-colored liquid, to which add gradually one-half ounce of ammonium fluoride c. p. (Merck's reagent), and allow the two to boil a few moments. Fumes of ammonium nitrate will be given off;" after cooling and crystallizing, a yellow sediment like sulphur will be formed, which is collected and dried; the amount will be about 128 gr. and will cost 62 cents, which is considerably cheaper than any other fluorescent compound now used; excellent results can be obtained by using this with the gelatine film of a dry plate to shorten the time in making a radiograph.

Improvement in X-Ray Tubes. OSTERBERG. *Elec. Eng.*, Feb. 10.—A short article describing a method for prolonging the life of a tube; two small rings of tin-foil are fastened around the tube just at the place to which the anode and cathode extend, the rings being electrically connected to the respective terminals which they surround; with this arrangement he has not been able to work a tube for a sufficient length of time to raise the vacuum so as to make it useless; the voltage required to produce good effects will then decrease considerably; 12 volts were used before, while only 4 then give the same effect; he suggests using a rubber cap, lined with tinfoil, to fit the terminals of the tube, as this can be put on as soon as the tube commences to weaken; this is to prevent the leakage from the edges of the tinfoil.

Prevention of X-Ray Burns. Elec. Eng., Feb. 10; an extract from a short article from a daily paper.—Dr. Cole received a wound on the arm from exposure to the rays, although sheltered by the usual amount of clothing; investigation showed that it was not due to the X-Rays themselves, but to a static electrical discharge, and he therefore now uses an aluminum screen, which entirely shuts off the static discharge.

Physiological Effects of X-Rays. HAWKS. *Elec. Rev.*, Feb. 10.—A short communication stating that hair began to grow in about nine weeks after it fell out, and came in thicker than before; he claims to have found out that working around X-ray tubes encourages the growth of hair, if the action is not prolonged too much; he also found that X-rays affect the eyes very much, and that glasses did not seem to afford any protection.

ELECTRO-CHEMISTRY AND BATTERIES.

Electricity in Chemical and Metallurgical Industries. KERSHAW. *Lond. Elec.*, Feb. 5; a continuation of his serial.—He continues the discussion of aluminum, stating that the only two processes used to-day are the Heroult and the Hall, both of which are electrolytic; the former is used at Neuhausen, Le Praz and Foyers, and the latter at New Kensington, Pa., Niagara and St. Michel. The details of both of the processes are taken from Richards' well-known book. In preparing a table of the energy efficiencies he assumes that the alumina undergoes direct decomposition with the separation of aluminum at the cathode and oxygen at the anode; the theoretical voltage then is 2.8; one electrical hp. of 735 watts should, therefore, produce 2.12 klg in 24 hours; in the table of efficiencies that at Niagara is given as 29 per centum, based on the actual production; at Neuhausen 28, an estimate, or 25 per centum on

a lengthy experimental run. It is suggested that economy might result from the use of a larger number of baths and a lower voltage per bath; it is expensive to maintain the heat of the bath by the electric current; he calls attention to the prevention of these losses and the question of finding some other means of maintaining the bath in a molten state. The cost of aluminum at Neuhausen is about 26 cents per pound, and at Niagara at 36 cents, the difference being due to the cost of the labor and is exactly balanced by a tariff of 10 cents per pound; if aluminum could be reduced 50 per centum in price it would make a much greater rival of copper than it is at the present time.

Air Accumulators.—Elek. Anz., Feb. 4.—A brief note from a daily paper, stating that Huebener has invented an accumulator which is not charged by electricity, but merely with the aid of air and heat; a plate 120 by 150 mm is said to be 6 to 7 times lighter than an "equally large plate" of a lead accumulator, and is said to have a capacity of 105 to 110 ampere hours; the efficiency (whatever that may mean in the present case, unless the amount of heat is referred to) is stated to be 91 per centum; no further information is given. It is suggested editorially that perhaps it is nothing more than the copper-zinc-alkali cell.

Electrolytic Analysis of Commercial Copper. Holland. *Elek. Anz.* Feb. 4.—A German translation of the recent French Academy paper describing the process, which he uses as chief of a laboratory of a large company (see Digest, Jan. 16).

Laboratory Furnace.—L'Elec., Jan. 23.—A description in French, with illustrations, of the distillation furnace mentioned in the Digest, Jan. 2, which are used in working with gold and silver.

Accumulators.—Elek. Zeit., Jan. 21.—A note stating that in the Schanschieff system the inventor claims that if only the frames of the plates do not touch, the active surfaces of the plates may be in close contact; he constructs his battery on this principle; they are used on the Ward electrical omnibus in London; a cell gives 1.75 amperes per pound and has a capacity of 5.5 ampere hours per pound; the weight includes the plates, the liquid and the cells.

Desilverizaton of Lead. Tommasi. *Zeit. f. Elektrochemie.*, Jan. 20.—The beginning of a German translation of some length of the article noticed in the Digest, Oct. 24, Nov. 7 and 21.

Alkalies and Bleach. Kellner. *Zeit f. Elek.*, Feb. 1.—A continuation of the illustrated description of his patents.

Electricity in Chemical and Metallurgical Industries. Kershaw. *El'ty.*, Feb. 8.—An abstract of part of the paper noticed in the Digest Jan. 23 and 30.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Rheostat. Mueller System. Elek. Zeit., Feb. 4.—A brief, illustrated description of an adjustable rheostat for measuring purposes, in which the wire is wound up and down over pins on the surface of a cylinder of large diameter, which is capable of turning around its axis and is provided with a fixed contact spring, which makes contact with successive loops of this wire; it is, therefore, a step by step instrument, but the intervals may be made quite small.

Method of Determining the Frequency of Oscillating Currents. Meyer. *Elek. Zeit.*, Jan. 28.—An article describing and discussing the theory of an instrument devised by him in which the frequency is measured by the increase in length of a steel wire, running through the core of a solenoid through which the currents are passed; the instrument has already been referred to in these columns; it is of use more especially for high frequency currents; he shows the way in which the energy may be calculated and assumes that there are no eddy currents, as the wire is made very thin; the application is shown by an example, in which a frequency of 30,000 was shown; the wire was 0.02 cm in diameter and 40 cm long, and was made of tungsten steel, whose magnetic properties were taken from experiments of Hopkinson; it appears that for every different kind of alternating curve wave a new constant must be determined.

Electrometer for Low Potentials. Perot and Fabry. *Comtes Rendus*, No. 4; noticed briefly in the *Lond. Elec.*, Feb. 5.—A description of an instrument, which is a modification of Kelvin's attracted disc electrometer, but the sensitiveness is greatly increased by bringing the disc within a few tenths of a millimetre of each other; the discs are made of silvered glass and their parallelism is controlled and the distance between them measured, by optical interference; the E. M. F. of the Clark cell was measured to within 1 in 1000.

Graphical Method for Determining the Effective E. M. F. from the Voltage Curve. Fleischmann. *Elek. Zeit.*, Jan. 21.—A short description of a method based on the principle of the centre of gravity of areas; the graphical method is for determining certain factors in the formula.

Apparatus for Eliminating the Effects of Vibrations. Julius system. L'Eclairage Elec., Jan 30, and *L'Elec.*, Jan. 20.—A French translation in part, with the illustration and description noticed in the Digest Aug. 1.

Cadmium Cell. Jaeger and Wachsmuth. *Jour. Inst. Elec. Eng.*, Jan.; abstracted from the *Wicd. Ann.*, Vol. 59, N. 11.—A long abstract of the description of their experiments of the Western cell, including some of the results.

Standarized Apparatus. Armagnet. *L'Eclairage Elec.*, Jan. 30.—A continuation of his long series of electrical instruments; in the present portion he discusses registering instruments.

Determination of the Magnetic Elements at Sea. Guyou. *Proc. Lond. Phys. Soc.*, Jan.; abstracted briefly from the Comptes Rendus, 123, p. 580.—He deducts a series of formulas which give with sufficient accuracy the corrections to be applied to the observations of magnetic elements when taken on board of a man-of-war.

Meter Testing.—Lond. Elec., Feb. 5.—The rules of the London County Council, which have been recently approved by the Board of Trade; they include the scale of prices for testing or inspecting meters at the consumer's premises.

Standaras of Light. Boistel. *Prog. Age*, Feb. 1.—A translation of the article noticed in the Digest Jan. 2, on the influence of the atmosphere on the Hefner and pentane lamps.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Microphone in Germany.—Jour. Telegraphique, Jan. 25.—An extract (in French) from the publications of the German Telegraph Department on the use of the microphone in the telephonic service in Germany; various forms are discussed.

Telegraph and Telephone Poles.—Petersen. *Lond. Elec. Rev.*, Feb. 5.—A translation from the Norwegian of the short paper referred to in the article on poles for line wires (under Wires, Wiring and Conduits), noticed in the Digest, Feb. 6.

Length of Telegraph Lines.—Elec. Tech., Jan. 31.—A note stating that according to recent statistics the length of all the telegraph lines in the world amounts to 7,900,000 km; the length of the submarine cable lines is 292,600 km; in Europe there are 2,840,000 km, in Asia 500,000, Africa, 160,000, America 4,050,000 and Australia 350,000.

Railway Signals. Hollins. *Lond. Elec. Eng.*, Jan. 29, and *Elec. Rev.*, Feb. 5.—The beginning of a reprint of an Institution paper, in which he describes briefly the electric interlocking systems in practical use, and more in detail the Sykes system used on the Great Eastern Railway, in accordance with his recommendations; it is illustrated with diagrams. The reprint is continued, but not concluded in the Lond. Elec. Eng., Feb. 5.

Field Telegraphs with the Chitral Relief Force in 1895. Dempster. *Jour. Inst. Elec. Eng.*, Jan.—A communication to the Institution, describing the equipment, the general arrangement and the work of that campaign. An abstract of the papers given in the Lond. Elec. Eng., Feb. 5.

Telephone Trunk Line System in Great Britain. Gavey. *Jour. Inst. Elec. Eng.*, Jan.—A reprint in full of his recent paper (see Digest, Dec. 5, 12, 19 and 26), and of the discussion in full.

Thompson's Pacific Cable. Sullivan. Lond. *Elec.*, Feb. 5.—He confirms the views of Taylor, see Digest, Feb. 6, that leaks gave improved definition, but reduced the size of the signal, thus necessitating an increased battery power, involving the well-known objections; he questions whether the propsed cable would accomplish what is claimed for it, that is, increasing the speed seven to eight times, or any speed sufficient to warrant so radical a departure in the construction.

The Telephone Situation. Jones. *Elec. Rev.*, Feb. 17.—The beginning of a reprint of a paper read at the Chicago Electrical Association, in which he reviews the history of the invention of the telephone from a technical standpoint.

Maximum Capacity of Telephone Switchboards. Pierard. *L'Elec.* Jan. 23.—A short article, in which he gives a formula for calculating the most economical number of subscribers to be connected to a section operated by one attendant. As generally constructed, the standard sections have 100 connections, which, he claims, is an arbitrary number, and endeavors to show how the best number can be arrived at; he considers only the times when the number of calls is a maximum, which occurs between 9 and 11, and 2 and 3 in the afternoon; he found that in the apparatus without a bell, it requires 12 seconds for one call with the Standard board; if the annunciators are raised automatically it requires only 10 seconds, but he prefers to use the first figure, thus making the maximum number which one attendant can handle as 300 per hour; he then develops the formula for determining the number of subscribers per section, which, although comparatively simple, cannot be given here; applying it to an installation of 1000 subscribers, he finds that the proper number is 117, and he therefore suggests to use nine boards of 110 each; the economy in the attendance, as compared with boards for 100 subscribers, would then be 10 per centum.

MISCELLANEOUS.

Rudder Steering Machine.—Elek. Zeit., Feb. 4.—A well illustrated description of the Essberger system, which is in use on some German steamers; it includes a transmitting apparatus, operated on deck or from the bridge.

Electro-Culture. Narkewitsch-Iodko. *L'Elec.*, Feb. 6.—A French abstract, with the table, of the paper noticed in the igest, Jan. 16.

Brussels Exhibition. Elek. Zeit., Feb. 4.—A list of the groups and classes pertaining to the electrical industry, and a list of the numerous subjects for which prizes are offered.

Physiological Effects of High Frequency Currents. Rocher. *Comptes Rendus*, No. 4.; noticed briefly in the *Lond. Elec.*, Feb. 5.—He describes the physical, physiological and therapeutic effects; the frequency is 7,000 per minute; the effects are said to be somewhat startling, but are not described in the abstract.

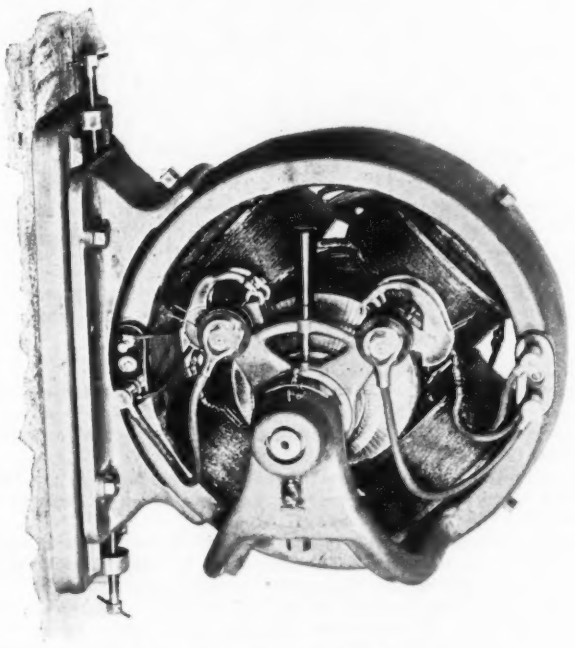
Electro-Therapeutic Terms.— Lond. *Elec.*, Feb. 5.—A communication by Burch on the new terms "zincative" and "zincability," introduced by Waller; it is followed by a short communication by Waller in defense of the terms. A communication by Waller on this subject is also contained in the Lond. Elec. Rev., Feb. 5. The Lond. Elec. Eng., Feb. 5, also discusses these terms.

Electrical Industry in Russia. Rosstin. *Zeit. f. Beleucht.*, Jan. 30.—An article describing the electrical industry in Russia and intended chiefly for those contemplating the exportation of electrical apparatus from other countries to Russia.

Technical Institution at Hamburg. Elek. Anz., Jan. 31.—An illustrated description of the Institution called Elektra, a sort of manual training school, which was opened in Hamburg about three years ago, and was since increased in size.

Multipolar Dynamos and Motors.

Fully appreciating the increasing demand for small dynamos and motors, and familiar with all requirements which must be met by such machines, the Ahlm-Edwards Electric Company, Medina, Ohio, has recently placed on the market a line of multipolar dynamos and motors of moderate capacity, which embody a number of excellent features. These machines are of the four-pole type, with inwardly projecting cores and poles attached to a circular outer frame, mounted on an adjustable base. The latter is of particular value in motors, as by its use the motor may be attached to the wall or ceiling without interfering with the arrangement or operation of the machine. The illustration shows a motor with base attached, to be bolted to a side wall. If it is desired to place the motor on the floor, the base is moved downward on the circular frame, through an arc of 90 degrees. Should it be necessary to attach it to the ceiling, the base is moved through a similar distance in the opposite direction.



MOTOR ATTACHED TO WALL.

The frame is of a special grade of cast iron, with separate magnet cores of cast steel bolted thereto. Special attention has been given to an even magnetic distribution from the polar faces of the latter. It is claimed that this serves to maintain an almost fixed commutation. The carbon brushes are mounted 90 degrees apart, in a holder rocking on the commutator end bearing. The machine is said to be nearly sparkless and the brushes remain in a fixed position after once set. Self-oiling bronze-lined bearings are used.

The armature is of the slotted drum type. The coils are shaped and insulated before being placed in position on the core. The commutator is divided into an unusually large number of drop, forged copper segments, insulated with mica.

Slow and moderate speed machines are built. The dynamos are compound wound. Motors are shunt wound.

New Automatic Motor-Starter and Quick-Acting Switch.

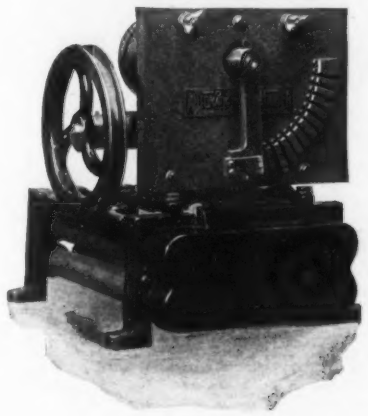
The accompanying illustrations represent the latest design of the Whittingham automatic motor starter and quick-acting switch, which is manufactured by the Automatic Switch Company, Baltimore, Md.

The operative principle of the starter is so well known, that a description is hardly necessary, but for those not familiar therewith, we would state that the automatic movement of the rheostat is accomplished by means of a small belt, connected directly with the motor, whereby each revolution of the motor armature cuts out, with absolute certainty, a predetermined part of the starting resistance. This method possesses advantages which are of great value in elevator and pumping work, as it acts as a safeguard against too rapid starting and forcing the motor under an over-load. The main feature to be commended is that the resistance is always cut out directly in proportion to the speeding-up of the motor, and can never crowd on current before the armature is prepared to receive it.

The construction of the starter has been so modified as to do away with all outside wires, the resistance terminals being completely encased and protected from accidental damage, and the bearings are of graphite and require no oil.

The Quick-Acting Switch embodies a number of novel and valuable points, which should recommend it to any one desiring a substantial circuit-breaker for power control. It is designed especially for use in connection with electric pumping and elevator work, and its construction is such as to make it particularly adapted to the exacting requirements of such work.

The movement required for the operation of the switch, is a reciprocating one, having a stroke of about two inches, which allows the use of a sliding rod passing through bearings on the base casting, and stopping thereon at each end of the stroke. The switching mechanism is thus entirely relieved from any strain or pull of the actuating rope, and is operated by the compression springs, arranged to give the quick motion, when making or breaking the circuit.



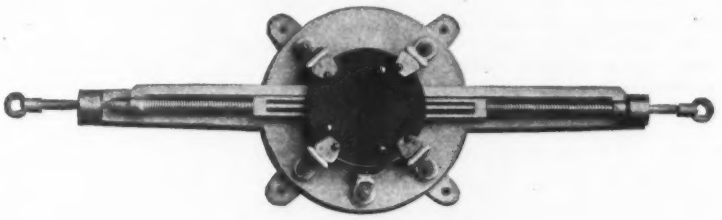
MOTOR-STARTER.

The contacts of the switch are pure copper castings, turned up to a true bearing surface, and arranged to engage each other, under spring tension, in a manner somewhat similar to the ordinary street car controller, each set of contacts being detachable and renewable without disturbing the operating parts of the switch.

By means of this switch, in connection with the Whittingham automatic rheostat, open tank, and pressure tank elevators may be operated automatically with satisfaction.

It will also be found equally useful in maintaining a certain level in the supply tanks of automatic sprinklers, etc.

Such electric freight elevators as require the motor to run continuously during the time the elevator may be used, can be more economically operated if arranged to be started and stopped from any floor, as needed, and this switch is well adapted for this purpose.



QUICK-ACTING SWITCH.

The automatic motor starters are made in sizes ranging from 2 h. p. to 30 h. p., and the switches supplied in two capacities, viz., 20 amperes and 60 amperes.

The Automatic Switch Company will shortly put upon the market a new form of automatic reversible controller and reversing switch, which combine many desirable features, and will furnish a reliable means of automatically handling elevator motors, without the use of dash-pot or moving magnets.

Static Ground Detector.

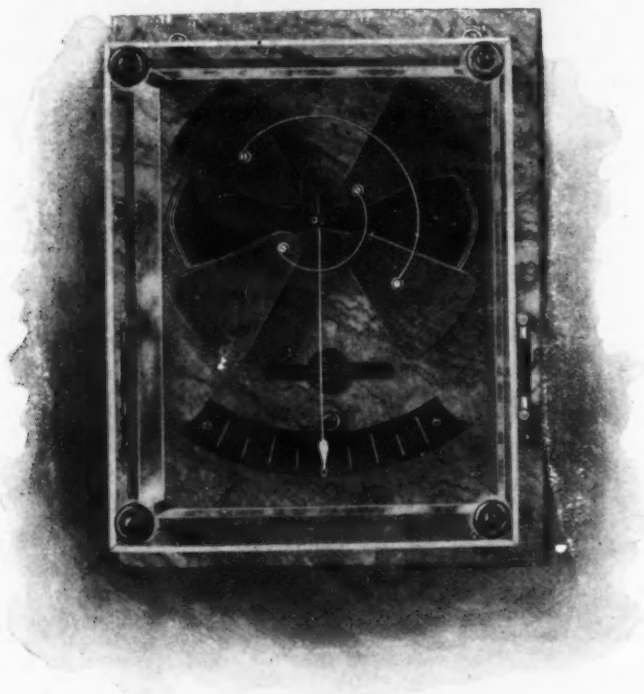
The static ground detector, manufactured by the Stanley Electric Manufacturing Company, Pittsfield, Mass., is essentially a differential static voltmeter, made up of four vanes fixed to a base and a movable vane carrying an index or pointer. The movable vane is made of sheet aluminum mounted on a shaft and held centrally, by two jewelled bearings, between the fixed metal vanes. The diagonally opposite fixed vanes are connected in pairs, and each pair is statically charged from one pole of some source of electrical supply. The movable vane which is connected to "earth" is inductively acted upon by each pair of fixed vanes, so that the stress produced by each is equal, but opposite. The movable vane in consequence takes a position equally between the fixed vanes, which position is, theoretically, the same whether the instrument is charged or not, and is the position of "no ground," the pointer pointing to the zero of the scale.

If one pair of fixed vanes and the movable vane are electrically connected, they are charged of like character from one pole of the source, the other fixed vanes being charged of opposite character from

the other pole. The action of the similarly charged vanes is to repel the movable vane, while the action of the other fixed vanes is to attract it. The two forces, acting in the same direction, the movable vane takes the position entirely within the oppositely charged vanes. The indicator pointing to the side of the similarly charged vanes and pointing to the position of "ground" for that side.

The static ground detectors are made in three types.

Type A—For use on any two-wire or four-wire circuits of any E. M.



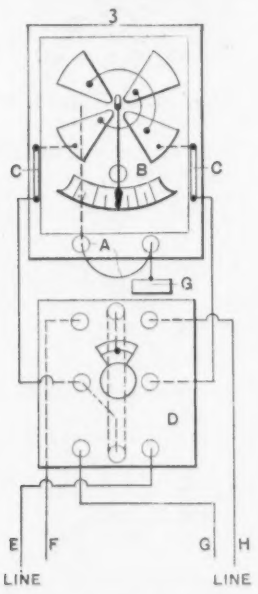
Static Ground Detector.

Fs. over 500 volts and under 5,000 volts, and for three-wire three-phase circuits of the same voltages.

Type B—Same as Type A, except for E. M. Fs. of 5,000 volts and higher.

Type C—For use only on three-wire two-phase circuits and for E. M. Fs. over 500 volts and under 3,000 volts.

The general appearance of all instruments is the same, differing only in details. There is no connection through any of the instruments between the line wires or between either of the wires and earth. It is not necessary to first introduce a temporary ground on the



Method of Testing with Ground Detector.

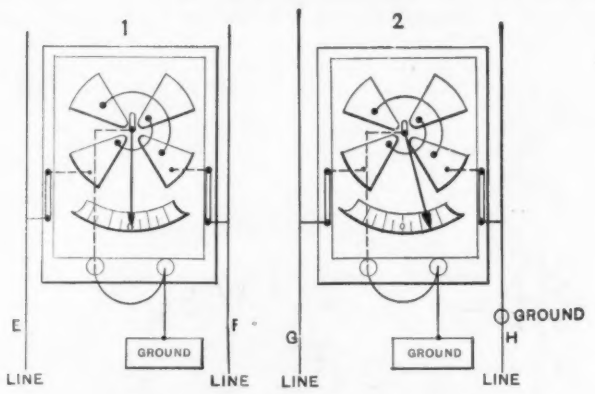
line in order to test for an existing ground, the characteristic defect of the old forms of ground detectors. This feature is of great importance as it insures greater safety to linemen and lessens the possibility of short circuits in the instrument itself.

The instrument consumes no energy and may be left continuously in circuit, indicating grounds as soon as they occur. An instrument for each circuit may, therefore, be used to great advantage.

In places where severe lightning storms are frequent, and where the line is not adequately protected by lightning arresters, it is advisable to disconnect entirely the ground detector or open the "permanent ground wire" during such storms. The first may be done by the commutating switch D, or by the "ground plug and cables A." (See diagram.)

Type A is mounted on a separate marble base, or directly on the switchboard. It is entirely covered by a case of plate glass, and all parts are perfectly insulated from the operator. In setting up the instrument, it is necessary to see that the shipping attachment, B, is removed, so that the pointer swings freely, and that the instrument is level, so that the pointer will stand at zero when at rest. The line wires are connected by small terminal plugs, through removable fuse blocks, *C*, *C*, on either front or back of the instruments, to the fixed vanes. By inserting a commutating switch, *D*, between the line wires and the instrument, it may be transferred safely and quickly from one phase to another, or to any one of any number of circuits.

Type B differs slightly in construction from Type A, in that the line wires are connected to a primary set of vanes, which are behind the visible fixed vanes, and are separated from them by large plaques of hard rubber and mica. The visible fixed vanes are charged inductively from the primary vanes, instead of directly from the lines. This type



Ground Detector Connections.

of instrument is mounted on a mahogany base, in which are embedded the primary vanes and the mica plaques. This construction secures perfect insulation for very high voltages, while in general appearance and in action the instrument is the same as Type A.

Type C ground detector, in construction and appearance is practically the same as Type A, differing only in having the vanes connected to the outside wires partially cut away.

The relative potential of the middle wire of a two-phase circuit is dependent upon the capacity with respect to the earth, and this, in turn, upon the extent of the lines and their distance from the earth. For very short or very long lines, therefore, special adjustment may be necessary in order to make the instrument indicate correctly, but generally the standard Type C instrument will meet all requirements and is furnished, unless special instructions are given.

Fuse wire used for all ground detectors is the well-known platinum-silver wire used in Cardew voltmeters. All ground detectors are properly fused before leaving the factory, and an extra length of fuse wire is furnished with each. If more is needed it can be obtained from the factory or from any electrical supply house. The ordinary lead fuse should never be used.

Improvements in the Electric Railway Motor.

The radical improvements that the electric railway motor has undergone have, as a rule, been so apparent that almost every electrician has noticed them. There are, however, many improvements of detail that are fully as ingenious and important as the more obvious ones. Prof. Sidney H. Short, Cleveland, Ohio, has taken out a patent, No. 546,560, covering a large number of these important details of construction. Though some of these features are familiar, from large use and liberal advertising, others, quite as important, are not generally known.

The first, and one of the most important features, is the suspension of the motor which is now used by the Walker Company, and which has been exhaustively described. This is claimed to be the only suspension in which the motor does not ride rigidly on the axle. A careful inspection of Fig. 1 will disclose two other features of value. The hinge by which the two halves of the motor casing is joined together is novel. It consists of an eyebolt, the shank of which passes through a lug, cast on the lower half of the casing, and prevented from slipping out by two check nuts. The eye itself hooks on to the hook in the upper half of the motor casing provided for it. It will be seen at once that this arrangement permits of the ready disengagement of the two halves of the motor casing. There is also an important magnetic advantage. By tightening the nuts on the shank of the eyebolt the magnetic joint adjacent thereto has its surfaces pressed into intimate magnetic contact. As railway motors must operate sparklessly, with fixed brushes, whatever the load, it is obvious that a balanced symmetrical field is highly desirable. Poor magnetic joints in the motor casing do not conduce to this condition, and thus this hinge apparently obviates an annoying fault. The suspension consists of a hook-shaped affair, that hooks on to the cross suspension bar and is secured thereto with a

pin. The figure shows that should this pin fail, the motor would not fall, for the hook would then come into play. This member of the suspension has an eye at its other extremity, which engages with a down-turned hook on the motor casing. This method of hinging and suspending the motor has the advantage of cheap production.

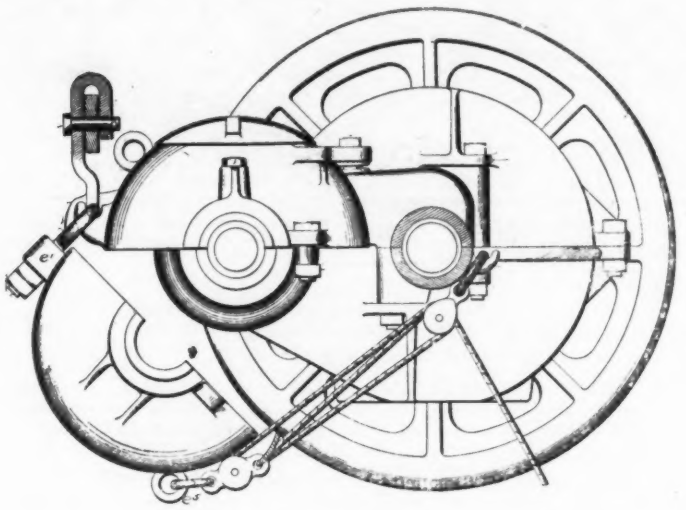
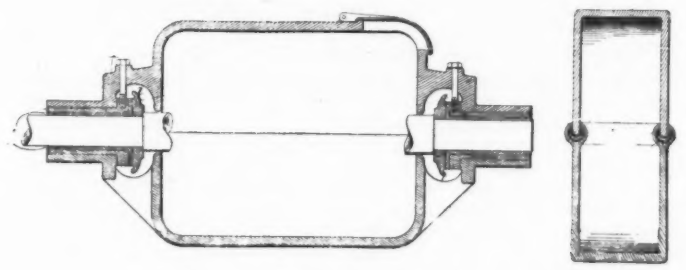


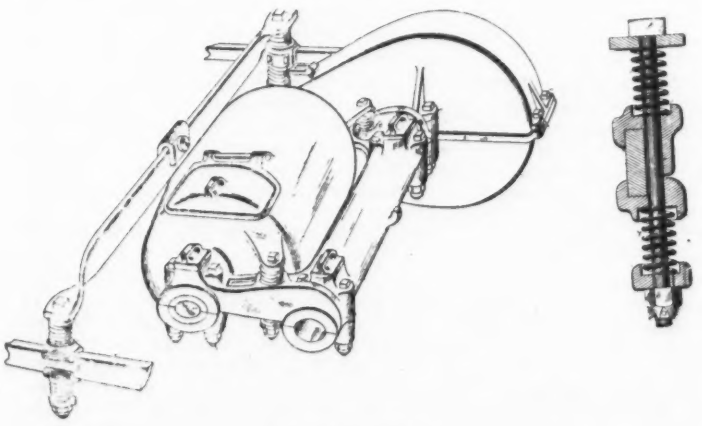
FIG. 1.

Fig. 2, which is a sectional drawing of the motor casing, shows the bearings entirely outside the casing, which is the only effective way of keeping oil out of the motor. The device of securing the journals to the upper half of the casing is also shown here. This enables the motor to be opened with the armature in either half.

The gear casing also has a feature that is largely used and is important, as it produces a water-tight case without any special tooling of the joints. Referring to Fig. 3, it will be noted that the lower half of the case is edged with a groove, while the upper joining edge is plain. The lower edge contains a circular strand of soft packing, preferably a tube. The outer retaining bolts draw these edges into each other, and the packing forms a tight joint. Like the other features of merit, it



FIGS. 2 AND 3.



FIGS. 4 AND 5.

is practical and conduces to cheapness of manufacture, without impairment of quality.

These features, which are covered by the patent, are the most important and largely used.

The spring suspended cross-bar, from which the motors are hung, is also included in this patent. The suspension is such that the cross-bar is supported by spring cushioning, whether its tendency to move is up or down. Quite frequently the strain on the cross-bar is an upward one, a fact that has not been generally appreciated.

Fig. 4 shows the spring suspended cross-bar, and Fig. 5 the clamping device, carrying the spring pockets, another patented feature.

In Fig. 1 is displayed the device of the upwardly turned hook, cast in the sleeve, surrounding the car axle and the eyebolt, in the lower half of the motor casing, for the obvious purpose there illustrated.

The last feature covered by the claims of this patent is the detachable shaft, illustrated in Fig. 6. It was devised to cover a need in the

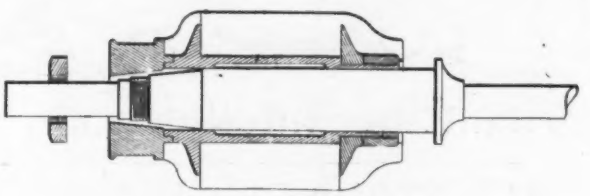
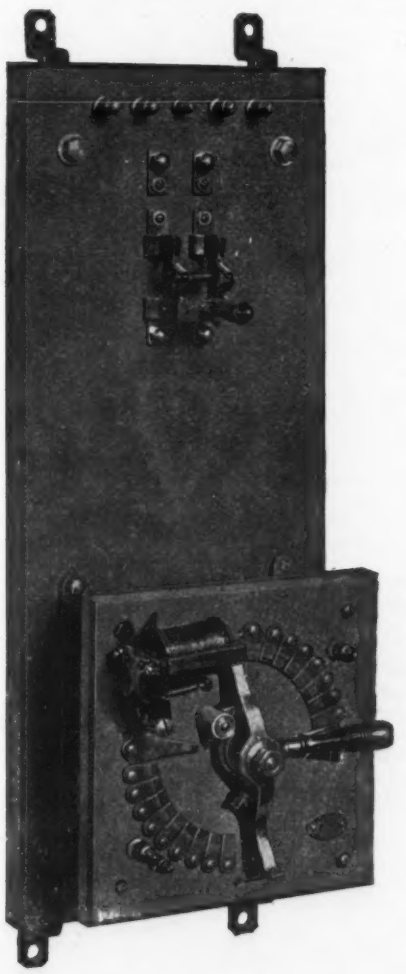


FIG. 6.

days when sprung shafts were very common, and prevents a sprung shaft from disabling an entire armature. Modern railway motor construction is such that sprung shafts are of such rare occurrence that this feature is not as important as in the earlier days of electric railroading.

Switchboard Panel for Motors.

The necessity of economy in the space occupied by operating appliances and the importance of making as few wiring connections as possible in small direct-current motor installations, has assumed the proportions of a demand which the General Electric Company meets by a series of small switchboard panels, designed for motors of the usual voltages and capacities, ranging from ½ horse-power up to 16 horse-power. The equipment of each panel consists of a main switch,



PANEL BOARD.

fuse-holder and motor starting rheostat with automatic release switch, the connection themselves being embodied in the panel. For motors up to 300 volts open fuses are used, while for voltages higher than 300 volts, magnetic fuse-holders are mounted on the panels.

The only connections necessary when installing the motor are those from the motor and mains to the five binding posts at the top of the panel. The panels, which are self-contained, are of plain slate, enameled slate or blue marble, the enameled slate being considered superior on account of its wearing qualities and finished appearance.

NEWS OF THE WEEK

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK, Feb. 17, 1897.

ELECTRICAL STOCKS.—At the close of business to-day the electrical stock list shows a general weakness, declines being noted in all cases where changes took place. The stocks that suffered declines since last quotations are: Electric Storage Battery, common; General Electric, common and preferred, and Westinghouse, common. Westinghouse, preferred, was the only exception to the rule and closed at an advance of ½ point.

TELEGRAPH AND TELEPHONE.—Bell Telephone is the only security in this list that shows an advance as compared with our last quotations, and that was only ½ point. The rest of the list, with very few exceptions, declined in price.

ELECTRIC TRACTION.—General quiet prevails in this class of securities. There were a few advances and some losses, but on the whole the changes were few and fractional. A few sales of Brooklyn Rapid Transit bonds, 5's of 1945, are recorded at a slight advance over last quotation.

	Par.	Bid.	Asked.
ELECTRICAL STOCKS.			
Chicago Edison Company	100	110	..
Edison Electric Ill., New York	100	104½	105½
" " " Brooklyn	100	..	97
" " " Boston	100	..	..
" " " Philadelphia	100	..	..
Edison Ore Milling	100	7½	10
Electric Storage Co., Philadelphia	100	26⅜	26⅝
Electric Storage, pref	100	28½	29
General Electric	100	34½	34⅝
General Electric, pref	100	73	75
Westinghouse Consolidated, com	50	23	25
" " pref	50	50½	51½
BONDS.			
Edison Electric Ill., New York, con. 5s	105	108	..
Edison Electric Light of Europe	100	75	85
General Electric Co., deb. 5s	100	95⅛	..
TELEGRAPH AND TELEPHONE.			
American Bell Telephone	100	217	..
American District Telegraph	100	29	39
American Telegraph & Cable	100	85	87½
Central & South American Telegraph	100	124	127
Commercial Cables	100	150	175
Erie Telephone	100	64¼	..
New England Telephone	100	102	..
Postal Telegraph-Cable	100	91	94
Western Union Telegraph	100	81⅝	82⅛
ELECTRIC TRACTION STOCKS.			
Baltimore Traction	25	18⅛	18⅜
Brooklyn Rapid Transit	..	21	21¼
Brooklyn Traction	100	..	14
" " pref	100	46	48
Buffalo St. Ry	100	72	74
Cleveland Electric Ry	100	..	..
Columbus St. Ry	100	40	43
Hestonville	100	50½	50¼
" pref		..	62½
New Orleans Traction	100	..	10
" " pref	100	..	35
North Shore Traction	100	22	25
" " pref	100	77	80
Rochester St. Ry	..	18	22
Steinway Ry	..	45	50
Union Railway (Huckleberry)		98	103
Union Traction, rcts $10 pd	..	12¾	13
West End, Boston	100	66	67
" " pref	100	90	90½
Worcester Traction	100	20	22
" " pref	100	95	98
BONDS.			
Brooklyn Rapid Transit 5s, 1945	100	80⅜	..
Buffalo St. Ry. 1st con. 5s	100	*107	110
Cleveland Elec. Ry. 1st mtge. 5s	100	102	104
*Columbus St. Ry. 1st 5s	100	94	96
Rochester St. Ry. 1st 5s	100	..	100
Union Railway (Huckleberry) 1st mtge 5s		*101	104
*Westchester Electric 1st mtge 5s	100	100	103

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Feb. 17, 1897.

MR. FRANKLIN S. TERRY, of the Sunbeam Lamp Company, Chicago, was in the city last week, arriving on Feb. 11.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, reports gross earnings for January, 1897, of $240,299.05, an increase of $22,117.51 as compared with the gross earnings for January, 1896. The net earnings were $124,543.50, an increase of $17,688.30.

MR. HENRY F. NOYES, solicitor of patents, formerly at No. 523 Monadnock Block, Chicago, Ill., has removed his office practice to the Syndicate Building, corner of Liberty and Nassau Streets, New York city. Mr. Noyes makes a specialty of electrical and technical work.

ELECTRICITY FROM CARBON WITHOUT HEAT.—Mr. Willard E. Case will deliver a lecture before the New York Electrical Society, on Feb. 24, on the subject of "Electricity from Carbon Without Heat." The lecture will be held at Columbia College, and will be illustrated by apparatus.

DAMAGE TO TELEGRAPH LINES BY THE STORM.—The storm on Feb. 12 did some damage to telegraph lines in the vicinity of Baltimore. In that locality sleet fell, and, as it accumulated on the wires, it thickened them to such an extent that they broke down in the wind. Poles were also prostrated. The damage, however, was easily repaired, and the interference with business was slight.

FREE TRIP AROUND THE WORLD.—Mr. Wm. Taylor, electrical manufacturers' agent, 203 Broadway, New York, was the successful competitor for the prize of a free trip around the world, offered by the New York *Evening Telegram* to the person making the nearest guess to Mr. McKinley's plurality in the popular vote for President. Mr. Taylor's guess was 597,397, which was 8 more than the actual number. Mr. Taylor has been overwhelmed with congratulations on his good fortune.

PROMINENT VISITORS IN NEW YORK.—During the week ending February 11 several prominent out-of-town visitors registered at the headquarters of the National Electric Light Association, 136 Liberty Street, among them being the following: S. G. Rooker, St. Louis, Mo.; James I. Ayer, Boston, Mass.; F. S. Terry, Chicago, Ill.; W. C. Bryant, Bridgeport, Conn.; F. Z. McGuire, London, Eng.; T. H. Brady, New Britain, Conn.; F. A. Gilbert, Boston, Mass.; E. B. Hatch, Hartford, Conn., and J. H. Rhotehamel, St. Louis, Mo.

KINSMAN & KNUDSON.—Messrs. F. E. Kinsman and A. A. Knudson have become associated under the firm name of Kinsman & Knudson, and will conduct a business as consulting and supervising electrical engineers. The office of the new firm is at 66 Broadway, and in addition to the lines of work mentioned above Messrs. Kinsman & Knudson will make expert examinations of new inventions and enterprises. Both gentlemen are well known to the electrical trades, and their many friends will, no doubt, wish for them a large measure of success.

THE HEBREW TECHNICAL INSTITUTE.—The formal dedication of the new school building of the Hebrew Technical Institute at 34-36 Stuyvesant Street, New York City, took place on the morning of February 12. The dedication exercises were appropriate for the occasion. Mr. Max Lowenthal, president of the Alumni Association; Professor Morris Loeb, chairman of the Construction Committee; Mr. James H. Hoffman and Hon. Theodore Roosevelt delivered addresses. At the conclusion of the formal ceremonies, the visitors made a tour of inspection of the new building.

THE NEW YORK & STATEN ISLAND ELECTRIC COMPANY, which was recently organized for the purpose of acquiring the electric lighting interests on Staten Island, on February 14 purchased the incomplete building at Livingston, begun three years ago by Mr. Erastus Wiman. The only bid was $1,000, which was made by Mr. Paul Cravath for the new company. The liens against the property aggregate less than $39,000. The property sold includes nearly 400 feet of valuable water front and a large brick and granite structure two-thirds completed, which was planned by Mr. Wiman to be one of the most substantial and complete electric power plants in the vicinity of New York. The consolidated interests includes the Electric Power Company, St. George, which supplies the villages of New Brighton and Edgewater; the Staten Island Electric Light Company, Port Richmond, and the Richmond County Electric Company, which recently established a plant at New Brighton, and is an offspring of the Staten Island Electric Railway Company. It is understood that work will be commenced at once to complete the Livingston plant, and it will be provided with an equipment sufficient to furnish the entire island with light.

THE NEW COMMERCIAL CABLE BUILDING, now in course of construction, at 22 Broad street, New York city, will have a very complete electrical equipment. About 3,000 incandescent lamps will be located throughout the building. Six Sprague screw electric elevators will be installed. These will be of the latest triple-deck type, making two sets of three elevators each. As at present arranged, the power plant is to consist of two Siemens & Halske, 150 kw, generators, each directly connected to a 225-hp engine. It has not as yet been decided whether another 150 kw. unit will be added, or whether the remainder of the necessary plant will consist of storage batteries. The entire electric light and power service is to be operated from the same generators, which will operate at 220 to 240 volts. All wiring will be on this basis, 220 volts to be used throughout. All auxiliary devices, such as sockets, switches, fuses, etc., are to be specially selected, with reference to this voltage. A number of ventilating motors and a double storage battery plant for the cable system will also be installed. The entire electrical work is under the supervision of Mr. Charles Cuttriss, electrician of the Commercial Cable Company, and Mr. Francis W. Jones, electrician of the Postal Telegraph-Cable Company.

PHILADELPHIA NOTES.

Branch Office of THE ELECTRICAL WORLD,
927 Chestnut Street,
PHILADELPHIA, PA., Feb. 16, 1897.

THE PHOSPHOR BRONZE SMELTING COMPANY, LTD., describes its well-known Delta metal in a little pamphlet just issued. Delta metal is not offered as a substitute for the well-known "Elephant Brand Phosphor Bronze," but occupies a distinct field of its own.

LARGE CONTRACT FOR ARMORITE TUBING.—We are informed by the Armorite Interior Conduit Company, Detroit, Mich., that the contract for Armorite tubing, to go into the new Girard Building, Philadelphia, calls for 200,000 feet, instead of 50,000, which was the amount stated in a note in a recent issue. This contract was secured through Messrs. Vallee Bros. & Co., Philadelphia agents.

MR. J. C. McNAUGHTON, Bourse Building, Philadelphia, who has taken the contract for the extension of the Olean Street Railway, Olean, N. Y., has just purchased at satisfactory prices a large quantity of steel rails for this work. This road is now successfully and profitably operated, and the proposed extension, which will be commenced in the Spring, will add largely to its revenues and afford needed accommodation to the people of the newly developed section.

THE ELECTRICAL MAINTENANCE COMPANY, INCORPORATED, 50 Broadway, New York City, has purchased the business of the Dynamo Electric Maintenance Company in Philadelphia, Boston, New York, Hoboken and Brooklyn, and the business of both concerns is now conducted under the management of the Electrical Maintenance Company. Mr. J. W. Cregar, the Philadelphia manager of this company, states that he has over 1000 machines in Philadelphia covered by the Maintenance Company's contracts, and that he has renewed all expired contracts. This speaks well for the manner in which this company lives up to its agreements with patrons.

MESSRS. MAYER AND ENGLUND are now settled in their new establishment, at No. 10 South Tenth Street, and are in a better position to give more prompt attention to orders. The firm's facilities for storing and handling an extensive line of railway material and supplies are the very best, and it has arranged to carry a full line of stock of all materials handled by it. One of the aims of the firm will be to make deliveries on the dates on which orders are received. The firm carries a large and complete stock of Nuttall gears and pinions for all railway systems, Union (Nuttall) standard trolley repair parts, together with a full line of overhead installation and brass fixtures for overhead line construction. Messrs Mayer & Englund have the good will of the trade, and the manner in which they are conducting their business cannot fail to bring them a satisfactory reward for their efforts.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Building, 620 Atlantic Ave.,
BOSTON, MASS., Feb. 17, 1897.

MR. NORMAN MARSHALL, vice-president of the Anchor Electric Company, Boston, spent several days in New York last week, and succeeded in capturing a good line of orders.

THE BELKNAP MOTOR COMPANY, Portland, Me., A. B. Field, Boston, manager, has removed its Boston office to 154 Congress Street, where is afforded better accommodations for its patrons and opportunities to better display its well-known specialties.

MR. W. F. FOWLER, until recently manager of the Hawks Electric Company, Boston, has accepted a position with the New England office of the Westinghouse Electric Company. Our congratulations are extended to both the Westinghouse Company and Mr. Fowler.

WEDDING.—Invitations are out for the marriage reception of Miss Isabel, daughter of Mr. and Mrs. Frank Ridlon, Dorchester, Mass., who will be married on February 24 to Mr. John Otis McFadden. The ceremony will take place at 48 Lawrence Avenue, Dorchester, between 8 and 10 in the evening. Mr. Frank Ridlon is president of the Frank Ridlon Company, Boston, Mass., and well known throughout the electrical world.

THE HAWKS ELECTRIC COMPANY, Boston, conspicuous for years in electrical engineering and constructing, reports some excellent orders recently, and that its business management will hereafter be under Mr. P. P. Crafts, who succeeds Mr. W. F. Fowler, recently resigned. Mr. Crafts brings to the company valuable experience, having been connected for a number of years with the well-known engineering firm of Stone & Webster, prior to which he was identified with central station work. Under his direction the Hawks Company will undoubtedly continue to do the satisfactory business it has always done.

THE AMERICAN ELECTRIC HEATING CORPORATION, Boston, this week announces the addition of a French coffee pot to its line of domestic utensils. In the past, such articles have been made with the electric heater permanently attached to the device, thereby making it necessary to have a number of complete outfits to do a limited amount of work. The coffee pot above referred to is made to fit a 4½-inch disc heater, and is of ample size for the wants of four people; is made of block tin, and so designed that all of the heat generated in the stove is used. Two electric stoves, with a stew pan and coffee pot, will, it is claimed, enable a family to cook a breakfast of coffee, toast and eggs in the time required to build a fire and get the ordinary stove ready.

THE SWETT & LEWIS COMPANY, Boston, manufacturers of Rontgen-ray apparatus, photographic and electrical supplies, has removed from 17 to 11 Bromfield Street. The new quarters are spacious and well adapted for the continued increasing business of the company. Succeeding, as it did recently, to the firm of G. A. Frei & Co., which had gained a creditable foothold in Rontgen-ray work, the Swett & Lewis Company has increased in credit and favor. It is constantly seeking to improve upon Rontgen-ray apparatus and devices, and will very soon introduce to the trade some novel and important specialties, among which will be new tubes and fluoroscopes. The company is receiving some flattering testimonials as to the quick and perfect working of its various Rontgen-ray specialties.

BUFFALO AND NIAGARA FALLS NOTES.

BUFFALO, N. Y., Feb. 10, 1897.

BUFFALO GENERAL ELECTRIC COMPANY'S BIDS FOR LIGHTING.—The bid of the Buffalo General Electric Company for arc lamps of 2,000 current-power each was as follows: For one year from March 1, 1897, 35 cents per lamp per night; for three years from March 1, 1897, 33 cents per lamp per night; for five years from March 1, 1897, 30 cents per lamp per night; for additional lamps on the same poles, the same price per lamp per night.

FORT ERIE FERRY COMPANY'S PROPOSED ELECTRIC ROAD.—Having taken the necessary steps to obtain an extension of charter, allowing the Fort Erie Ferry Railway to extend its line to Bridgeburg and to the proposed race track, the International Ferry Company and Fort Erie Ferry Railway made application to the Council of Bridgeburg, Ont., for permission to lay tracks along Niagara Street to the boundary of the village. It was decided to permit the company to lay tracks for the proposed electric railway on such streets, but in no case will tracks be permitted on the road skirting the Niagara River and running under the International Bridge.

PROTEST FROM THE NIAGARA POWER COMPANIES.—The two power companies of Niagara Falls, whose business interests dwarf those of all the rest combined, have made a sweeping protest against the plans of the Harbor Commissioners appointed about a year ago under an act of the legislature for the reclaiming of a large piece of land under water in front of the City of Niagara Falls, on which it is the intention of the projectors of the plan to build wharves, store-houses and elevators. The opposition of the two power companies to the scheme is based on the report made to them by Engineers Brackenridge and Johnson to the effect that if the reclamation business goes on under the present plans it will prevent a full flow of water to the power houses and thus perhaps cripple them. Mr. Brackenridge's report to the Niagara Falls Power Company begins by saying it is the intention of the Harbor Commissioners to excavate a channel 450 feet wide, immediately adjacent to and on the north side of the parcels to be reclaimed. He says the distance from Grass Island to the lands under water now owned by the Niagara Falls Power Company is 260 feet. It is therefore apparent that the proposed harbor lands would separate the narrow channel from the main waters of the Niagara River for a distance of about 2⅛ miles, the only connection between the channel and the main waters of the river being by means of three narrow strips about 400 feet in width. Mr. Brackenridge says the filling in of this land would block the flow of water to the power houses. He concludes by saying the action of this barrier on the water "would tend to generate anchor ice, which would be a serious obstacle to the successful operation of the power companies' works." Mr. Johnson's report to the Hydraulic Power & Manufacturing Company is substantially the same.

EXTENSION OF TIME.—A condition of the grant by Buffalo to the Cataract Power Company was that it be prepared to supply 10,000 horse-power to the consumers here on or before June 1, 1897. In asking the city for an extension of the time for the transmission of 10,000 horse-power, the company says: "As you are aware a transmission line has been built and a thousand horse-power are now being supplied and used in this city. The Cataract Construction Company is energetically pushing the work of extending the wheel pits and installing the necessary turbines and dynamos to furnish the full supply, but this work, together with the installation of the necessary machinery, cannot by any possibility be completed by June 1, 1897. Very much of the work has necessarily been experimental in its nature. Many conditions have had to be met by means new to constructors of electrical appliances, and those best advised as to the nature of the problem and the means at

hand for its solution one year ago are now most enthusiastic over the amount of work already accomplished. It is hoped to have available here considerably more power than that now supplied, but we cannot obtain or deliver 10,000 horse-power by June 1, 1897. We pledge ourselves that the work shall be pressed with all the energy at our command. We have an agreement with the Cataract Construction Company for the delivery to us of the first 9,000 horse-power produced by it with the appliances now being installed, and we have contracted to deliver here 4,000 additional horse-power before November 15 next. As soon as the weather permits, we hope to begin the construction of our conduits and delivery system. The cost of the work to date has been defrayed by the subscribers to our stock. To meet the cost of future construction it will be necessary to issue bonds, and we cannot expect to place these bonds unless our grant as to time be one with which we can comply. We therefore respectfully ask that you modify the grant by substituting the words December 31, 1897, for June 1, 1897." The Cataract Power & Conduit Company will undoubtedly get the time extension asked.

Pittsburg Notes.

Pittsburg, Pa., Feb. 15, 1897.

MR. O. B. SHALLENBERGER, formerly chief electrician of the Westinghouse Electric & Manufacturing Company, is president of the Colorado Electric Power Company. This is a corporation that has just been organized for the purpose of supplying power to the mines of the Cripple Creek district. It is the intention of the company to develop a water power at Cañon City, where it can be transformed into electrical energy under very favorable conditions, and to transmit it to Cripple Creek, a distance of 25 miles.

MR. L. B. STILLWELL.—This gentleman, whose resignation from the Westinghouse Electric & Manufacturing Company was announced in The Electrical World of Feb. 13, will on April 1 next assume his new duties as electrical director of the Cataract Construction Company and the Niagara Falls Power Company. In his new capacity he will have entire supervision of the electrical work at Niagara for the two companies mentioned. In the development during the coming year of the 35,000 additional horse power that has been arranged for, a number of new and interesting problems will doubtless arise, and their solution will afford congenial employment for Mr. Stillwell's well-known engineering knowledge and skill. That all difficulties will be overcome, his ability, backed by the resources of the companies he represents, leaves no room for doubt. The appointment must be regarded as a peculiarly fitting one, and both Mr. Stillwell and the Niagara companies are to be congratulated upon the creation of the new and important post of electrical director and the excellent appointment to fill the position.

THE HOME TELEPHONE COMPANY has had drawn up and presented to councils an ordinance which is now in the hands of the Committee on Corporations. It is expected to come up for passage at the next meeting. The company has for months been making an active canvass in Pittsburg and Allegheny, and has secured more than five thousand subscribers, and now asks councils for rights of way for underground and overhead lines through the streets. The rates demanded by the new company are much lower than the present charges of the Central District and Printing Telegraph Company, and strong opposition is looked for from the latter organization. Mr. John Campbell, late manager of the local office of the Postal Telegraph Company, has succeeded Mr. Adams in charge of the Home Company's Pittsburg branch, and since his appointment has been actively engaged in extending the list of subscribers and securing rights of way, etc. He estimates that the new company will require, after councils have granted the asked-for privileges, about one year to build its lines and equip exchanges and put them in full operation, covering the two cities and adjacent territory. The very best and most modern instruments, appliances and methods will be used, and a service first-class in every respect is promised.

THE ANNUAL BANQUET of the Engineers' Society of Western Pennsylvania was held on Thursday evening, Feb. 11, at the Duquesne Club. One hundred and twenty-five members were present, and the occasion was a most enjoyable one. Among the prominent representatives of the electrical branch of the profession were Mr. C. F. Scott, of the Westinghouse Electric & Manufacturing Company; Prof. R. A. Fessenden, of the Western University; Mr. H. W. Fisher, electrician of the Standard Underground Cable Company; Mr. G. F. Greenwood, general manager of the Consolidated Traction Company; Capt. A. E. Hunt, president of the Pittsburg Reduction Company, and E. E. Keller, general manager of the Westinghouse Machine Company. Mr. George S. Davison filled the position of toastmaster in a very happy manner. Nearly every department of engineering science was included in the list of toasts. Mr. C. F. Scott spoke in behalf of the "Electrical Engineer," and Capt. Hunt responded for the "Metallurgical Engineer." The festivities were continued until a late hour, and the dinner was voted the most successful event of the kind ever held by the society. The Engineers' Society of Western Pennsylvania is one of the oldest and most prosperous bodies of the kind in the country, and upon its membership list are enrolled the names of many engineers of international reputation.

St. Louis Notes.

St. Louis, Mo., Feb. 13, 1897.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY has just made a large shipment of supplies to Brazil and Cuba. The Brazil parties write that if the first shipment proves satisfactory they will buy in much larger quantities. The Missouri Telephone Company is quite busy, and is having all the work it can attend to.

ELECTRIC LIGHTING IN MEXICO.—R. P. Serano, commercial agent for Mexico, is in the city, with R. B. Montiverdi, of Hermosillo, and Sonora and R. Muchertu, of the same State. The last-named is here for the purpose of purchasing supplies for an electric light plant. It is probable that Mr. Serano will make his headquarters in America at St. Louis.

STREET CAR MEN ARE NOT ANXIOUS.—A bill is being prepared by a member of the City Council authorizing electric street railway companies to furnish light, heat and power to patrons along their roads. If the bill becomes a law, the competition would cut prices. The street railway men, however, do not seem anxious to go into the electric lighting field. They have their hands full already, and it is doubtful if they would care to take advantage of the bill.

BARRED OUT.—The City Counselor decided last week that the Postal Telegraph-Cable Company, the Western Union Telegraph Company, the Laclede Power Company and the Trans-Mississippi Electric Company will not have conduit space, as they have not complied with the required conditions. All the companies but the above four complied with all the requirements. The Laclede, it is said, will go out of business soon and resume as the Phoenix Company. The Trans-Mississippi Company has filed no bonus at all. The decision in regard to the Postal and Western Union companies was a surprise to the managers of those concerns, as they claim to be ready to bury their wires at once if given a chance, although they have only partially complied with the conditions.

CONDUIT MATTERS.—The Bell Telephone Company of Missouri, the Telephone and Telegraph Service Company and the Kinloch Telephone Company, being telephone or telegraph companies, have been notified that, provided they comply with the requirements within ten days, they can begin work on a joint conduit system on the south side of St. Charles Street. The board will have two separate conduits built, one for companies using low-tension wires on one side of the street, the other for companies using high-tension wires on the other. The low-tension wire-using companies will be started on the east and west streets, and the high-tension companies on the north and south streets. The electric light, heat and power companies, nine in all, have been notified that they can begin work on a joint conduit on the east side of Broadway, provided they also comply with the conditions.

Pacific Coast Notes.

San Francisco, Cal., Feb. 6, 1897.

MR. E. B. KITTLE, representing the Interior Conduit & Insulation Company, New York, was recently in the city on a business tour of the Coast.

THE PACIFIC POWER COMPANY, San Francisco, has closed a contract with the Westinghouse Electric & Manufacturing Company for an additional 500-volt, 4-pole generator, having a capacity of 112 kilowatts. It will be installed as a reserve machine for the power circuits.

THE FORT WAYNE ELECTRIC CORPORATION, Fort Wayne, Ind., has closed a contract with the Mutual Electric Light Company, San Francisco, for a 200-kilowatt M. P. generator, with a potential of 250 volts. It will furnish direct current for the company's power circuits.

STREET LIGHTING IN SANTA CRUZ.—Santa Cruz, Cal., will have Pacific avenue lighted from end to end with arc lights, through the enterprise of citizens, by a plan agreed upon by the Board of Trade. Property owners contribute, each, 3 cents per month a running foot of their premises. The Santa Cruz Electric Light Company furnishes the current.

THE PEOPLE'S MUTUAL TELEPHONE COMPANY, San Francisco, has secured a large number of subscribers. President J. L. Crittenden has promised that an opposition telephone system, costing one million dollars, will be installed, if a sufficient number of long-time subscribers can be secured. He also promises the construction of long-distance lines, connecting this city with Portland, Ore.

ELECTRIC LIGHTING IN SAN FRANCISCO.—San Francisco has experienced a renaissance of electric street lighting within the past few weeks. Street improvement clubs, one after another, took up the subject of overhead arcs in the middle of the streets. Property owners entered into six-month contracts for lights, and at the inauguration of the special service, celebrations were held, with considerable ceremony. Bonfires, oriental lanterns and red-fire increased the effect of the lights. In this way, over 300 arc lights were added to the ordinary illumination of the city. Polk street indulged in an elaborate carnival. San Francisco is, in fact, a gas-lighted city. Arc lights are used for city lighting, as a rule, only in the outlying districts, so-called. The commercial lighting by electricity, however, is very thorough, and Market street is lighted by arc lights placed in front of the stores.

CONSOLIDATED INTERESTS.—The details of the recent consolidation of the Edison Light & Power Company and the San Francisco Gas Company, are being carried out according to programme. The stockholders of the former company are receiving in exchange for each of their shares one and one-third shares in the San Francisco Gas & Electric Company. The San Francisco Gas Company's stockholders exchange share for share. Neither of the old companies will go out of existence at once. The capital stock of the electric company has been reduced to $800,000, the extent of its bonded indebtedness, while the gas company's capitalization has been reduced to the value of its real estate holdings. A dividend of $1 per share has been declared upon the stock of the San Francisco Gas & Electric Company, payable after the first of next March. The San Francisco Gas & Electric Company will make a considerable addition to the capacity of the electric generating stations on Jessie street. All of the incandescent lights and the constant-potential arcs are supplied by these stations. The details of

the new installation have not been settled, but the new equipment will be up to the requirements of the latest practice in lighting. The units will probably be double those now in use. The company's electric stations are taxed to nearly their full capacity.

CANADIAN NOTES.

MONTREAL, Feb. 11, 1897.

DUNDAS, ONT.—The ratepayers desire to secure the installation of an electric light plant.

KNOWLTON, QUE.—The electric light company proposes putting in a new plant in the spring.

SHAWVILLE, QUE.—A local company proposes putting in a plant for electric street lighting.

PARRSBORO, N. S.—A local company is being organized here to put in a plant in the spring for electric street lighting.

STURGEON FALLS, ONT.—The ratepayers voted on a by-law on Feb. 11, to provide funds for the purchase of an electric light plant.

HALIFAX, N. S.—The City Engineer has been instructed to report on the cost of installing an electric light plant to do the city lighting.

SOUTHAMPTON, ONT.—The by-law to purchase the Saugeen water power and install an electric light plant, has received the sanction of the ratepayers.

CHATHAM, ONT.—The promoters of the proposed Chatham City & Suburban Electric Railway will apply to council for an extension of their franchise to include electric lighting.

PORT ARTHUR, ONT.—The street railway company will likely put in a plant at the power house for the lighting of the town, to consist of a dynamo, capable of running 1,300 sixteen c. p. lights.

BELLEVILLE, ONT.—A scheme has been set on foot to extend the electric railway west from Belleville to Trenton, and hence north to Tweed, there to connect with the Canadian Pacific Railway.

NIAGARA FALLS, SOUTH, ONT.—Messrs. A. G. Hanan and Ed. Davis, of Niagara Falls, have secured the control of the Niagara Falls, Clifton & Drummond Street Railway, and will probably convert the road into an electrical system in the Spring.

ROSSLAND, B. C.—A company of Eastern capitalists has been formed to build an electric railway from here to Spokane, a distance of 160 miles. It is likely that the Rossland branch will be constructed this year, but steps will be taken at once to build that portion of the line from Spokane to the boundary line.

NELSON, B. C.—A company has been organized here, with a capital stock of $20,000, to put in an electric light plant. The work of construction will be commenced as soon as the water rights have been obtained from the Government. The company will order one 5,000-light machine, step-up and step-down transformer; also 150-light arc machine.

OTTAWA, ONT., Feb. 14, 1897.

MUNICIPAL AID SOUGHT.—A proposal is before the council of the County of Carleton, Ont., for municipal aid towards the construction of an electric railway from Richmond to Bell's Corners, to connect near the latter point with the proposed line of the Ottawa Electric Railway to Britannia.

WANTS ENLARGED POWERS.—Application is being made to the Ontario Legislature for an act to amend the act incorporating the South Essex Electric Railway Company, granting power to construct an electric railway from the town of Windsor to the town of Sandwich, and from there to the town of Amherstburg, thence to the town of Leamington, in the County of Essex.

PROPOSED EXTENSION.—The municipal council of the City of Chatham, Ont., has agreed to submit a by-law to the people, endorsing a proposal of the Chatham City & Suburban Electric Railway for an extension of the road to Wallaceburg, Dresden, Petrolia and other northern points, as well as Blenheim, Rondeau, Charing Cross and other points south, and of granting a contract to the company for electric lighting of the city at 25 cents per arc lamp per night, up to not less than 100 lights.

EXTENSIVE ELECTRIC RAILWAY SCHEME.—The Board of Directors of the Huron & Ontario Electric Railway held a meeting at Toronto recently to consider a proposal to construct an electric railway in the northwestern portion of the province. The scheme means the outlay of several millions of dollars. The road is projected to run from Port Perry on Lake Scugog to Kincardine on Lake Huron, a distance of 191 miles from east to west. Two branches will act as feeders to the main line, one from Flesherton to Meaford, 28 miles, and the other from Walkerton to Goderich, 55 miles, making a total mileage of 274 miles.

ANNUAL MEETING.—The annual meeting of the Canadian General Electric Company was held at Toronto last week. During the past year an agreement has been concluded between this company and the General Electric Company, providing for the surrender by the latter company of 6,000 shares of the capital stock of the former company, having a par value of $600,000, receiving in lieu thereof 500 shares of 6 per centum preference stock, of a par value of $150,000, thereby reducing the capital stock of the company by $450,000. The Canadian shareholders were offered 1,500 shares of the preference stock, all of which was readily taken. This company is one of the largest, if not the largest, manufactories of electric supplies in the British Dominions. The old Canadian directors were re-elected, as follows: President, W. R. Brock; vice-president, H. P. Dwight; second vice-president and managing director, Frederic Nicholls; Board of Directors: Hon. George A. Cox, Robert Jaffray, J. K. Kerr, W. D. Mathews and Hugh Ryan.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Feb. 3, 1897.

THE TELEPHONE TRUNK-WIRE SYSTEM.—On Saturday next the Postal Telegraph Department will take over from the National Telephone Company the working of the trunk circuits between Liverpool and Manchester, completing the transfer of the entire urban telephone system of the United Kingdom, from the National Telephone Company to the Post Office.

ROYAL SOCIETY.—At the last meeting of the Royal Society three papers of electrical interest were read. One was by Dr. Hopkinson, on "The Capacity and Residual Charge of Dielectrics, as Affected by Temperature and Time," another by Professors Fleming and Dewar, "On the Electrical Resistivity of Electrolytic Bismuth at Low Temperature and in Magnetic Fields," and a third by Prof. J. C. Bose, of Calcutta, on "The Selective Conductivity Exhibited by Certain Polarizing Substances." Prof. Bose, I may say, has discovered that crystals, such as nemolite and crysolite, are efficient polarizers of Hertz waves, in so much as the vibrations in one plane are absorbed and the vibrations in the other are transmitted. He now finds, in accordance with Maxwell's law, that the electrical conductivity of these crystals in the direction in which the waves are absorbed is some 14 times greater than in the direction in which the waves are transmitted.

CENTRAL STATION FIRE INSURANCE.—As I mentioned in my last letter, a meeting of the Municipal Electrical Association was held on Thursday last, to discuss a paper by Mr. Councillor Pearson, of Bristol, dealing with the subject of municipal insurance, the subject of discussion being more especially the fire insurance of municipal central stations. The cause of the disturbance is the fact that the insurance offices have recently raised the rate for central stations from 5s to 10s 6d. After a discussion lasting two or three hours, several resolutions were carried. Briefly, these recommend that an endeavor should be made to discover the basis, if any, upon which the tariff offices fix the premiums for central station risks, and to collect data with regard to the aggregate amount of electrical property insured, premiums paid and claims made. After having armed themselves with these particulars, municipalities are urged to take some joint action, with a view to securing a reduction of the present rates, and, failing success, they are advised to give up insuring their property in the tariff offices and either self-insure out of the profits of the electric light undertaking, or insure the stations in non-tariff offices. Many speakers were strongly in favor of a general scheme of municipal mutual insurance, but it was pointed out that legislative sanction would have to be obtained for this new departure, and that it was very doubtful whether the local authorities would go hand-in-hand in this matter, and, unless they did so, the scheme could not possibly be a success. So far as could be gathered from the speeches, municipalities have very little to complain of in the matter of premiums, except in the case of the insurance of electric supply works, and in this particular, one may venture to say, whilst waiting more accurate data, that the premiums are exorbitant. Looking at the enormous profits made by the fire insurance companies, one would expect that, on the whole, it would be cheaper for profit-earning electric light departments to set aside a portion of their profits every year for the purpose of an insurance fund, rather than to insure at the rate of 10s 6d per centum in an insurance office. So far as the insurance of electric light stations is concerned, the municipalities certainly occupy a very strong position, seeing that for the most part these concerns are making a profit, and there would be no difficulty in obtaining the sanction of the ratepayers for self-insurance, so that, should the fire offices prove obdurate, they will lose the business entirely.

General News.

NEW INCORPORATIONS.

THE ANN ARBOR ELECTRIC COMPANY, Ann Arbor, Mich, has filed articles of incorporation with the Secretary of State at Lansing. Capital stock, $16,000.

THE LINTON ELECTRIC LIGHT AND POWER COMPANY, Linton, Ind., has been formed with a capital stock of $9,000. The promoters are Silas F. Kyle, Harry E. Daugherty and J. T. McGinnis.

THE LANCASTER ELECTRIC LIGHT, HEAT AND POWER COMPANY has been incorporated at Lancaster, Pa. This company has secured the contract to light the city for five years from June 1 next.

THE DETROIT TELEPHONE COMPANY, Detroit, Mich., has been incorporated with a capital stock of $1,000,000. The incorporators are William S. Holmes, Alex. I. McLeod, Charles Flowers, Frank A. Vernor and others.

THE ARKADELPHIA WATER WORKS AND ELECTRIC COMPANY has been incorporated at Arkadelphia, Ark., with a capital stock of $50,000. Those interested are C. V. Murray, E. W. McCorkle and W. E. Barkman.

THE DEPEW AND LANCASTER ELECTRIC LIGHT AND POWER COMPANY, Depew, N. Y., has been incorporated with a capital stock of $20,000. The incorporators are John N. Scatcherd, Joseph L. Hunsicker and George R. Teller.

THE DETROIT SWITCHBOARD AND TELEPHONE CONSTRUCTION COMPANY, Detroit, Mich., has been organized with a captial stock of $100,000. Those interested are William S. Holmes, Alex. I. McLeod, Charles Flowers, Frank A. Vernor and others.

Telegraph and Telephone.

DUQUOIN, ILLS.—Mr. J. J. Downey, owner of the telephone exchange, will petition the council for a franchise for an electric light plant.

SHAWANO, WIS.—The new line between this city and Gillett, built by the Northern Wisconsin Telephone Company, has been completed. It will soon be extended westward; also to Green Bay, Seymour and Appleton.

CHICAGO, ILL.—The Central Bell Telephone Company, of Venezuela, which is otherwise known as the Caracas, Valencia & Interior Telephone Company, operating in Venezuela, but organized under the Illinois laws, has been placed in the hands of a receiver on application of J. E. Clark. Attorney William J. English was appointed receiver.

MENOMINEE, MICH.—The Northwestern Telephone Company will ask for a franchise to establish an exchange in this city, which, it is said, will be operated in direct competition with the Bell Company. The Company proposes also to build a toll line through the Upper Peninsula. It has already started one south into Wisconsin.

YOUNGSTOWN, O.—The right of way is being secured for a telephone line to connect Kingsman, Burghill and Orangeville with the Jefferson-Warren line at Cortland. The branch will run by Fowler, Nutwood and Hartford. The Jefferson-Warren Company has purchased the Geauga County line, and it will be connected with the Youngstown Company's line.

DAYTON, O.—The Ohio Telephone & Telegraph Company has brought suit against the Cincinnati & Miami Valley Traction Company to restrain the latter from constructing and operating an electric line along a certain route of the Cincinnati pike, to which the telephone company claims prior and exclusive right. It is claimed that the proximity of the electrical system of the traction company to the wires of the telephone company will destroy the usefulness of the latter, and that such construction would be an interference with the telephone companies' rights. A temporary restraining order was issued.

Electric Light and Power.

PONCA, NEB.—The Council will put in an electric plant to be operated in connection with the waterworks.

HOLDEN, MO.—The Council proposes to call an election to vote on the issue of $10,000 electric light bonds.

RUTLAND, VT.—The question of the city possessing its own electric light plant is being agitated at this place.

OWATONNA, MINN.—An election will be held March 9, to vote on the question of issuing electric light bonds.

NAZARETH, PA.—The Nazareth Town Council is considering a proposition to put electric lights on the streets.

ZUMBROTA, MINN.—A franchise has been granted to O. D. Armstrong to establish an electric light plant here.

ANN ARBOR, MICH.—The Regents of the University of Michigan will ask for an appropriation to build an electric plant.

CHARLOTTE, MICH.—At a recent special election held here on the question of establishing an electric light plant, the proposition was voted down.

BARABOO, WIS.—The City Council will be asked to grant an electric light franchise to a company composed of residents of this place. It is intended to erect a $20,000 plant.

SPARTA, WIS.—The State Board of Control has petitioned for $10,000, to be expended for an electric light and central heating plant, for the school at Sparta for Dependent Children.

PENACOOK, N. H.—There is a movement on foot to establish an electric lighting plant at the Valley of Industry, Boscawen Plain, from which the county farm at North Boscawen and this village could be lighted.

RUTLAND, VT.—The Rutland Electric Light Company has been attached for $60,000 by the General Electric Company and Mr. M. J. Francisco, of this city. It is stated that these two creditors backed the Rutland Electric Light Company for large sums of money without credit, and these suits were brought to adjust the matter.

SCRANTON, PA.—The full service of the Scranton Illuminating, Heat & Power Company was re-established on the night of February 6, after the recent fire which destroyed the company's plant. The dynamos have been placed in a temporary structure and the work of re-establishing the service was a notable achievement.

MARTINSBURG, W. VA.—The City Council has submitted to the Legislature a number of amendments to the charter, asking for more extensive municipal power and the right to submit to the voters of the city the question of issuing bonds, not to exceed $50,000, for the purpose of constructing and equipping an electric light plant to do the municipal lighting.

RUTLAND, VT.—The subject of municipal ownership of an electric light plant for the city has come to the front recently, and the Board of Aldermen have adopted resolutions authorizing the appointment of a special committee to make a full investigation of the feasibility and practicability of municipal ownership, etc. A series of public meetings will be held to discuss the matter pro and con.

FOSTORIA, OHIO.—Mr. B. G. Tremaine and associates, of Cleveland, have entered into an agreement, in consideration of a bonus of $10,000, to erect in this city a factory for the purpose of manufacturing incandescent electric lamps. The factory will have at the start a capacity of about 4,000 lamps per day. The company will have an authorized capital of $100,000, all of which has been taken, so it is stated.

MARIETTA, O.—On February 8, $15,000 was voted for the enlargement of the electric plant in this place. The Marietta Electric Company will start its plant soon. It has installed two gas engines, one of 130 horse-power and one of 100 horse-power. The engines use natural gas. The company will supply power for the operation of the street railway and conduct an incandescent lighting business. The gas engines are looked upon as something of an experiment. They are built at Fort Wayne, Ind.

The Electric Railway.

LINCOLN, ILL.—A receiver has been appointed for the Lincoln Electric Railway Company.

MARION, IND.—Col. W. E. Avery is attempting to secure a franchise for an electric road in Grant County.

PITTSBURG, PA.—The ordinance granting right of way over Talbot Avenue to the Braddock Electric Railway Company, was passed.

WORCESTER, MASS.—The Worcester and Marlboro Street Railway Company has bought a lot in Northboro for a site for a power house.

AMESBURY, MASS.—The Haverhill & Amesbury Road is looking to the furthering of its interests, by extending its electric line to Seabrook.

CHAMBERSBURG, PA.—The Chambersburg Borough council has passed a resolution favoring the granting of a trolley franchise in that town.

WARREN, OHIO.—The Trumbull Electric Railroad Company announces that it will extend its line to Leavittsburg within eighteen months.

WILMINGTON, DEL.—An effort will be made at the present session of the Legislature to secure a charter for the Wilmington & West Chester Electric Railway Company.

WESTMINSTER, MASS.—The officers of the Gardner, Westminster & Fitchburg Electric Railway have accepted the franchise as prepared by the selectmen, and the road will be built this summer.

CHICAGO, ILL.—The Lake County Board of Supervisors has granted a 20-year franchise over the public road between Lake Forest and Fort Sheridan, asked for by the Bluff City Electric Railway Company.

NEW YORK CITY.—Certificates of extensions of routes have been filed by the Metropolitan Traction Company with the Secretary of State, and it is proposed to begin work as soon as permission is granted.

DELEVAN, WIS.—At a meeting of the village board, a 20-year franchise for an electric street railway was granted to the Delevan Light & Fuel Company. The road will run between and connect the towns of Delevan Lake.

CLEVELAND, O.—A new electric road is to be built next summer from Cleveland. It will be known as the Cleveland and Eastern Railroad. The company was incorporated by H. Tilden, Roger M. Lee and Charles E. Fish.

HARRISBURG, PA.—The Doylestown and Eastern Electric Railway Company has been granted a charter to construct a line between the two places named, touching at Danborough and Point Pleasant. The capital stock is $10,000. Harry J. Seymour is president.

NEEDHAM, MASS.—The selectmen have granted a franchise to the Newton & Boston Street Railway Company for a road from Newton boundary, at Newton Upper Falls, along various streets and avenues, to the New England depot in Needham. Work on the road will be commenced in the spring.

GREENBUSH, P. O., ALBANY, N. Y.—There is a movement to construct an electric railroad between Greenbush and Crooked Lake, touching at Bath, Defreestville, Averill Park and Glass House Lake. The power is to be located at Greenbush. The men interested are Oscar F. Hilt, of Greenbush, and others.

ROCKLAND, MASS.—The Bridgewater, Whitman & Rockland Street Railway Company, recently organized, applied for franchises in the towns of Bridgewater, East Bridgewater, Whitman and Rockland. The proposed line is to begin near the railway station in Bridgewater, and extend through the towns of East Bridgewater, Whitman, Abington and Rockland, where it will connect with the Hanover and Hingham street railway lines.

Obituary Note.

EDWIN W. JENNEY.—Mr. Edwin W. Jenney, secretary and treasurer of the Jenney Electric Motor Company, Indianapolis, Ind., died on Feb. 9 and was buried on Feb. 13. Mr. Jenney was born in New Baltimore, Mich., Aug. 11, 1855, and was graduated from the Michigan University. He was connected with the Jenney Electric Motor Company almost continuously since 1889, and in his death the company loses a valuable officer and efficient business man.

Personal Notes.

MR. J. E. LOCKWOOD, of the Michigan Electric Company, Detroit, Mich., is in the city.

MR. CHARLES H. ROCKWELL, treasurer of the Buckeye Electric Company, Cleveland, Ohio, made a flying visit to New York last week.

LEGAL NOTES.

THE WATSON SWITCH PATENT.—On February 10, Judge Showalter, in the Federal Court, Chicago, Ill., handed down an opinion in the suit of the Bell Telephone Company against the Western Telephone Construction Company for alleged infringement of the Watson telephone switch patent. Judge Showalter held that the Watson switch was anticipated by the previous condition of the telephone art in the prior Watson and Roosevelt patents. The Judge states that in view of the state of the telephone art as indicated in this case, his judgment is that there is no novelty nor invention in any of the eight claims set up by the Bell interests; nothing more than the use of clever mechanical expedients in arranging a subscriber's outfit. The bill was therefore dismissed for want of equity. It is stated that another suit is pending in the same court between the same parties, involving infringement of the Roosevelt patents.

LAMP SUITS.—The United States Electric Lighting Company has brought suit in the Circuit Court of the Northern District of Ohio against the Warren Electrical Specialty Company, Warren, Ohio, for infringement of patent No. 264,986, issued to Edward Weston, Sept. 26, 1882. This patent covers the cellulose lamp-filament referred to in the last issue of THE ELECTRICAL WORLD. Suit has also been instituted by the same company against the Davis Electrical Works, Springfield, Mass., for infringement of the same patent. This suit was brought in the Circuit Court of the District of Massachusetts. The Westinghouse Electric & Manufacturing Company has commenced suit in the Circuit Court of the Northern District of Ohio, against the Warren Electrical Specialty Company, Warren, Ohio, for infringement of patent No. 426,417, issued April 22, 1890, and covering the Packard mercury pump. The two suits against the Warren Electrical Specialty Company were filed on Feb. 8, and the one against the Davis Electrical Works on Feb. 12. The answers to the former will be due April 5 next, and the answer to the latter about May 3.

Trade and Industrial Notes.

MR. E. J. WARING, 136 Liberty Street, New York, has secured the exclusive selling agency for the United States of the "Daylight Electric Desk Lamp."

MR. GEO. H. COOK, treasurer of the Electrical Maintenance Company, 50 Broadway, New York, reports business exceptionally brisk for this time of the year.

GOULD & EBERHARDT, Newark, N. J., have just issued a little pamphlet on their gear cutters. It also includes a treatise on Eberhardt's correct water gear cutter grinder.

MR. JOHN T. McROY, of Chicago, has received from the Kinlock Telephone Company, St. Louis, of which Mr. Hopkins J. Hanford is general manager, an order for seven miles of terra cotta conduit.

THE BALL & WOOD COMPANY, 120 Liberty Street, New York, is installing three 80-hp direct connecting engines to three 50-kw Western dynamos, in the Polhemus Memorial Clinic, Brooklyn, N. Y.

THE METROPOLITAN ELECTRIC COMPANY, Chicago, reports a large trade in medical and experimental apparatus during the past month, the demand being especially large for Röntgen ray apparatus.

MR. F. E. PRITCHARD, formerly connected with the People's Electric Light & Power Company, Oswego, N. Y., has established an electrical repair and supply business on his own account, at 119 East First Street, Oswego.

THE SIEMENS & HALSKE ELECTRIC COMPANY OF AMERICA has issued a pamphlet giving a partial list of plants installed by it and a few testimonials concerning the operation of its apparatus. The list covers the entire country, and judging from the letters presented, users of the apparatus are experiencing the best of satisfaction.

BALL ENGINES.—The Wilmington Gas Light Company, Wilmington, N. C., is installing a 350-hp horizontal cross-compound engine, built by the Ball Engine Company, Erie, Pa. A 60-hp engine, direct connected to a 25-hp General Electric dynamo, has been recently placed in the Church Home and Infirmary, of Baltimore, Md., by Crook, Horner & Co., representing the Ball Engine Company, Erie, Pa.

THE GARTON-DANIELS ELECTRIC COMPANY, Keokuk, Ia., reports that its orders for the months of December and January amounted to more than double those received during the same months a year ago. While the number of arresters sold was more than doubled, the prices averaged higher. This condition of affairs is regarded by the company to indicate that its goods have become established, and the demand for them is naturally increasing.

CONTRACT CLOSED.—W. C. Balida, manager of the Utica Electrical Manufacturing & Supply Company, Utica, N. Y., has closed a contract with the Walcott & Campbell Spinning Company, of New York Mills, for a complete modern lighting plant for its new yarn mill. The installation will consist of an 800-light Eddy incandescent dynamo, forty-five Manhattan 150-hour enclosed arc lamps and 262 Buckeye incandescent lamps, together with switchboard.

THE CENTRAL ELECTRIC COMPANY, Chicago, has taken the Western agency for the Wagner alternating current ceiling fan motor. This motor is constructed on radically new lines, and has many new commendable features. It is said to be noiseless in operation and consumes 120 watts when running at normal speed, of 125 revolutions per minute, and is guaranteed to produce an agitation of the atmosphere without producing the same result on the purchaser.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is distributing two very neat and tasty circulars of some of its specialties and staple goods, one circular being devoted to porcelain tubes and insulators, and the other to sparkless and Boudreaux dynamo brushes. In connection with the circulars, the Electric Appliance Company is quoting a revised discount on these goods, low enough to warrant the assurance that considerable business will result. It will be pleased to send circulars and quote discounts where they have not already been received.

THE BERLIN IRON BRIDGE COMPANY.—The steel work in the new building for the Catholic Protectory, at Van Nest, N. Y., has been awarded to the Berlin Iron Bridge Company, East Berlin, Ct. This building is two stories high, having a floor supported by steel posts and girders. The roof construction is to be steel trusses, supporting slate covering. The building is 60 feet wide and 160 feet long, having projections 60 feet long and about 30 feet wide on either side at the centre for the organ loft and gallery. The ceiling of the upper floor, or main auditorium, will be arched and the gallery erected of light steel work, will be much lighter than it would have been had wooden construction of wood columns and beams been used.

MR. F. W. HAWKINS, 27 Thames Street, New York City, New York and Philadelphia, agent for the Electric Engineering & Supply Company, Syracuse, N. Y., seems to be keeping the well-known line of switches and switchboards manufactured by this pioneer concern well in the lead. Among the contracts recently corralled by Mr. Hawkins in this line, the large switchboard for the new Commercial Cable Building, Broad Street, New York City, is probably most notable. This board is to be built of marble panels, measuring complete 7½ by 20 feet, and is to be finished in the highest state of the art. Another marble switchboard of fair proportions, measuring 8 by 10 feet, will also be furnished for the St. Marguerite's Hospital, Pittsburg, Pa.

MR. W. S. HADAWAY.—The electric heating engineer is probably one of the newest developments of this age of specialists in engineering. No one is, however, more fit to specialize in this direction than Mr. W. S. Hadaway, Jr., who has for some time past been established at 107 Liberty Street, New York city, where he has provided ample facilities for the development of all work coming under the head of electric heating. Mr. Hadaway was previously the chief electrician for the Central Electric Heating Company, and has practically devoted his entire labors to the study of electric heating problems. Mr. Hadaway has recently perfected a number of special electric heating applications in various manufacturing processes, and several large heating plants have also recently been completed by him.

THE McGUIRE MANUFACTURING COMPANY, Chicago, Ill., has issued an excellently illustrated catalogue of its electric trucks of all descriptions, snow plows and sweepers, Columbia street car heaters, ratchet brake handles, etc. Some artistic half-tone illustrations of these well-known trucks are given, together with views of different railway equipments using McGuire trucks. The various styles of trucks manufactured by the McGuire Company are briefly described and the constructional dimensions of the same are given for those interested. A fine half-tone illustration of a snow sweeper tells in one glance a story concerning the device that would require pages of print for description. The Columbia magazine street car heaters are artistically illustrated, as is also the ratchet brake handle, which the McGuire Company has been making for the past two years. These handles have given good satisfaction in service. The pamphlet gives a list of railways using McGuire trucks, and it is a long one.

Business Notices.

THE ILLUSTRATIONS in this issue were made by the Photo-Engraving Company, 67-71 Park Place, New York City.

BATTERY CUT-CUT CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, 105 South Warren Street, Syracuse, N. Y.

Illustrated Record of Electrical Patents.

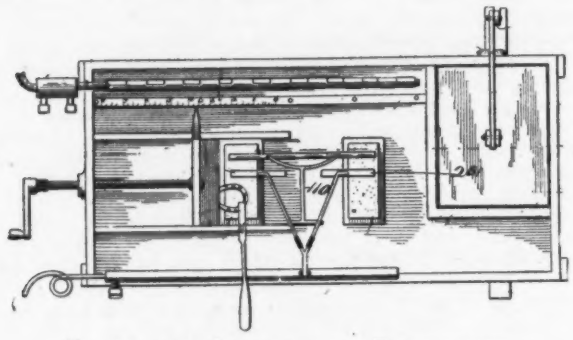
576,545. APPARATUS FOR ELECTRICALLY HEATING METAL; G. D. Burton, Boston, Mass. App. filed March 30, 1895. In an electrolytic heating apparatus, the combination of a vessel for containing an electrolytic solution, a hearth composed of two members for supporting a metal to be heated, one of said members being movable relatively to the other, and means for moving one of said members relatively to the other.

576,551. TELEPHONE TRANSMITTER; M. E. and E. C. Clark, Minneapolis, Minn. App. filed Sept. 23, 1895. The combination of a diaphragm made of an electrical insulating material, such as paper or parchment, with a multiple contact device secured directly upon said diaphragm and provided with a large number of contact points or projections, a disc or button to engage said contact-points and a binding-piece of material similar to that of which the diaphragm is

formed, and whereby said button or disc is secured upon the diaphragm and said multiple contact device.

576,621. ELECTRIC SWITCH; M. Schalscha, Hoboken, N. J. App. filed Feb. 20, 1896. A switch adapted to be carried by a moving device to regulate the current through a motor for said moving device, comprising a switch in the electric circuit and having a series of contact-plates, a switch-arm for closing the contact through the plates, a rotary shaft on which said arm is mounted, a rotary shaft having gear connection, with the arm carrying shaft, and arms extended radially from the last-named shaft.

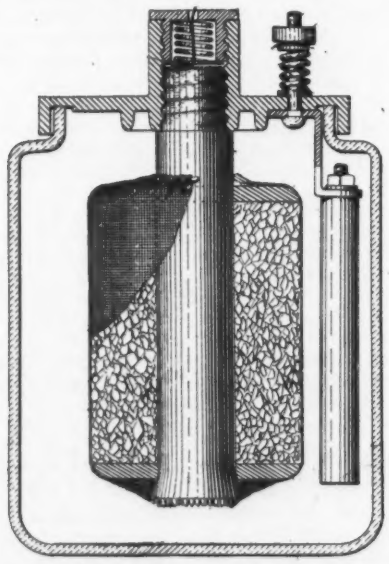
576,622. ELECTRIC LOCOMOTIVE AND RAILWAY SYSTEM THEREFOR; M. Schalscha, Hoboken, N. J. App. filed Feb. 20, 1896. A transporting device comprising a car, an electric motor thereon, an electric current conveyor on the track-bed, a trolley having connection with said conveyor, an arm extending from said trolley and having a longitudinal slot, a hammer on the car truck having a pivot extending through said slot, and a connection between said hanger and the motor.



No. 576,545.—Apparatus for Electrically Heating Metal.

576,710. VENTILATED FUSE PLUG FOR ELECTRIC CIRCUITS; H. C. Wirt, Schenectady, N. Y. App. filed Nov. 20, 1896. A hollow ventilated fuse-plug for electric-circuits, having a metallic contact-ring surrounding its sides and a metallic contact portion at its lower end, a recess in its upper portion provided with a bridge, and a fusible wire having its ends connected to the metallic terminals and curved over said bridge.

576,720. GALVANIC BATTERY; H. J. Brewer, New York, N. Y. App. filed May 18, 1894. The combination with a battery cell, of a carbon element therefor comprising a central carbon pencil, a body of material containing carbon closely surrounding the pencil, top and bottom plates between which the body of material is held, one of



No. 576,720.—Galvanic Battery.

the plates being loose upon the pencil, a pervious sack inclosing the body of material and said plates, a draw-string at one end of the sack around one of said plates, and a draw-string at the other end of the sack for closing the corresponding end of the sack around the movable plate and compressing the body of material.

576,721. TROLLEY SYSTEM; W. G. Caffrey, Reno, Nev. App. filed April 2, 1896. In the electric propulsion of vehicles the combination of a positive and negative conductor arranged in a vertical plane, one above the other, and a trolley to travel in contact with the conductors, and consisting of pivoted bars forming an extensible and contractible frame, slotted plates in which the frame-bars are guided, contacts carried by the plates and removable and reversible arms pivoted to the plates and carrying contacts, said arms being provided with springs for holding their contacts up to the conductors.

576,732. ELECTRICAL REGULATING DEVICE; J. F. Kelly, Pittsfield, Mass. App. filed July 24, 1893. The combination of an alternating-current generator used as a source of electrical supply, a circuit from the same for the transmission of the electrical energy developed, and a regulator consisting of induction motor connected with the circuit and driven at a speed above that of synchronism.

576,766. ELECTRIC HEATING APPARATUS; A. Robertson, Taunton, Mass. App. filed April 5, 1895. An electric radiator composed of a casing perforated at its bottom and along its upper front portion; a plurality of heating-bars each made up of a wide thin bar of metal, in insulating covering and a heating coil; and supports to hold each bar on a slant upward and inward across the casing all arranged to cause the air flowing through the lower perforations of the casing to be deflected against the back of the casing and to eddy about the heating-bars before escaping through the upper perforations in the front of the casing.

576,802. ELECTRIC ARC LAMP; H. Baurlin, Aarburg, Switzerland. App. filed May 11, 1896. In an electric arc lamp the combination of an electromagnet included in a shunt-circuit of a main armature having side-plates and clock-work supported thereon carrying a ribbon from which the carbon is supported, a horizontal pendulum, a friction-disc upon the axis thereof, and an auxiliary armature elastically supported upon the main armature controlled by said electromagnet and having an adjustable break-screw to press upon said friction-disc.

576,804. TELEPHONE APPARATUS; C. E. Buell, North Plainfield, N. J. App. filed April 24, 1895. A charged line, an annunciator in said line, normally open connections from said annunciator to a switchboard, equalizing resistance between said annunciator and a charging-generator, a continuity-preserving key between said annunciator and a charging-generator, and a normally-connected storage battery joined to said generator.

576,810. OUTLET BOX; J. J. J. de Rycke, New York, N. Y. App. filed May 2, 1896. In an outlet box, a cover and body, a semi-circular disc forming a part of each and matching to each other when the cover and body are assembled, a thin web joining each disc to the adjacent portion of the casting, the said web being thinner than the metal of said disc and adjacent portion, to determine the line of break in removing said disc.

576,813. TELEPHONE TRANSMITTER; J. F. Gilliland, Adrian, Mich. App. filed Dec. 21, 1895. The combination with saucer-shaped electrodes provided with a groove about the facing edges, of a resilient

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non-conducting ring located in said grooves, granular-conducting material confined between said electrodes and opposite axial bearings for supporting the united electrodes.

576,854. STATION INDICATOR; J. D. Keen and J. H. Roberts, Louisville, Ky. App. filed Sept. 24, 1896. In a station indicator, the combination with a spring-motor, of drums having wound thereon a perforated apron, pinions fixed on the shafts of said drums, a gear-wheel driven by said motor, means for causing said gear wheels to rotate said pinions and their drums alternately in opposite directions, a ratchet-wheel driven by the motor, an armature carrying a detent adapted to engage the ratchet wheel, to stop the motor, an electromagnet operating to withdraw the armature to release the ratchet-wheel, a push-pin arranged in contact with the apron, a spring for causing said push-pin to project through the perforations in the apron, and connections between the push-pin and armature for moving said armature away from the magnet when the push-pin enters one of the perforations and cause the detent to engage the ratchet-wheel and stop the motor.

576,933. ELECTRIC LIGHTING FOR VEHICLES; J. A. Ageron, Paris, France. App. filed Aug. 2, 1895. An automatic circuit-breaker, consisting of a rotatable hollow body adapted to contain a conducting fluid and constructed of two sections of conducting material insulated from each other.

576,936. BATTERY; F. B. Badt, Chicago, Ill. App. filed Sept. 7, 1894. In a battery cell, the combination with a jar, of a channel surrounding the upper edge of said jar, a cover for said jar provided with a rim adapted to fit in said channel, an insulating liquid in said channel, and an opening in said rim, the distance from the surface of the insulating liquid to the opening in the rim being insufficient to prevent the escape of gas under the internal pressure set up by the action of the elements of a Leclanche cell.